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EXPLORATIONS AND SURVEYS FOR A RAILROAD ROUTE FROM THE MISSISSIPPI RIVER TO THE PACIFIC OCEAN.

WAR DEPARTMENT.

REPORT

OF

EXPLORATIONS FOR A ROUTE FOR THE PACIFIC RAILROAD,

ON THE LINE OF THE

FORTY-FIRST PARALLEL OF NORTH LATITUDE.

BY

LIEUT. E. G. BECKWITH,

THIRD ARTILLERY.

1854.

INTRODUCTORY LETTER.

WASHINGTON, D. C., *December* 30, 1854.

SIR: The very limited time left for the preparation of the accompanying report, after completing, on the last of November, that of Captain Gunnison's explorations of last year, has only permitted me to complete it in the most hasty manner.

The outline-map which accompanies it was also made in the greatest haste, but it is believed will be sufficient for the immediate wants of the government. The more finished maps are in course of preparation, and will be transmitted to the department as soon as they can be completed. A geological report of the country explored by Captain Gunnison and myself is nearly complete, and, with the reports upon the plants and specimens of natural history collected during the trip, will be submitted as early as practicable, the drawings for their illustration not yet being complete.

My assistants in the explorations embraced in the accompanying report were Mr. Sheppard Homans, astronomer, by whom the observations and computations for latitude were made, our defective instruments not admitting of observations for longitude; Dr. James Schiel, geologist, who is still engaged upon his report; Mr. F. W. Egloffstein, topographer, to whom I am indebted for superior topographical sketches and the preparation of the accompanying outline map, and who is still engaged in making the elaborate maps of the survey; and Mr. J. A. Snyder, to whom the collection of botanical specimens was intrusted, but who was also constantly employed in making meteorological observations, and who has been employed, since my return, as an assistant in making computations of barometric observations under Mr. Lorin Blodget, by whom they were discussed, and whose notes accompany the tables. For the energy, ability, and cordial co-operation of each of these gentlemen, and of Brevet Captain R. M. Morris and Lieutenant L. S. Baker, of the regiment of Mounted Riflemen, in charge of the escort from that regiment, in the execution of the duties of the exploration, I desire to express my obligations and esteem.

I am, sir, with much respect, your obedient servant,

E. G. BECKWITH,
1st Lieutenant 3d Artillery.

Hon. JEFFERSON DAVIS,
Secretary of War.

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ERRATA.

Page 77.—Under the head of Corrected Barometer, No. 551, observation of December 12, at 12 o'clock m., for 25.713, read 25.613.

Page 77.—Under the head of Corrected Barometer, No. 496, observation of December 12, at 3 p. m., for 25.768, read 25.668.

Page 80.—Under the head of Corrected Barometer, No. 551, observation of February 21, at 9 a. m., for 25.698, read 25.598.

Page 80.—Under the head of Corrected Barometer, No. 551, observation of March 3, at 9 a. m., for 25.758, read 25.658.

Page 87.—Under the head of Corrected Barometer, No. 551, observation of May 8, at sundown, for 25.758, read 25.658.

REPORT.

CHAPTER I.

From Great Salt Lake City east to Green river, and back, by the Weber and Timpanogos rivers, respectively—April, 1854.

Explorations resumed.—Advance of spring.—Winter of 1853–'54 at Great Salt Lake.—Timber near the city.—Impracticability of the present wagon-road over the Wahsatch mountains in winter.—Winter mail-route.—Weber river; its lower cañon; fine grazing district: condition of cattle grazed during the winter, during which they crossed the mountains.—Cattle-trade in Utah.—Rocks of lower cañon; its passage by railway.—Snows in cañon.—Wagon-road possible from Ben Simon's creek east.—Second cañon of the Weber; its crossings, railroad practicability, and character of its rocks and dikes.—Valley of Weber river from the head of the second cañon to White Clay creek.—Emigrant-road.—Conglomerate sandstone.—Snow.—Character of White Clay Creek valley; game; snow-banks.—Uinta mountains.—Porcupine Terrace.—Timber.—From White Clay creek to Bear river; its character and valley where crossed.—Snow-blindness.—Sulphur creek.—Muddy creeks.—Black's Fork.—Greatest depth of snow encountered.—Extensive view.—Greatest altitude of the line; its railroad practicability.—Black's Fork valley.—Beaver-dams.—Smith's Fork.—Fort Supply.—Fort Bridger.—Railroad route thence eastward.—Snow-storm.—Crossing to Henry's Fork.—Sioux war-party.—Henry's Fork valley.—Ascent of mountain at the end of our eastern course.—General description of the country from this point.—Snow-blindness of party, and of "Ring."—Plains crossed in returning to Smith's Fork.—Black's Fork.—Muddy creek.—Bear river.—White Clay creek.—Nests of edible bugs.—Attempt to find a direct passage to Kamas prairie.—Mountains and fields of snow encountered.—Country seen from mountain summit.—Impracticability of continuing the passage.—Timber.—Return to White Clay creek and Weber river.—Fine grass-fields.—Impracticability of this route for roads.—Rocks and soil.—Weber river valley above White Clay creek.—Kamas prairie.—Timpanogos river.—Round Prairie.—Timpanogos cañon; its railroad practicability.—Utah Lake valley.—Railroad line *via* the foot of the Lake and Cedar valley, or by the valley of the Jordan and north of Oquirrh mountains.—Return to Salt Lake City.

Sir: Explorations were resumed on the 4th of April, 1854, for a route for the Pacific railroad under my direction, by the surviving portion of Captain Gunnison's party, (which had wintered at Great Salt Lake City,) under the original instructions given to that officer to explore the most available passes and cañones of the Wahsatch range, and cross the Weber and Bear rivers to the coal basin of Green river, and thence proceed to Fort Laramie.

Leaving the city, we proceeded north along the shore of the lake, passing through the Mormon settlements and farms, which occupy the most fertile and best watered sections of the narrow belt of land lying between the shore and the base of the mountains. Spring was already considerably advanced in the valley; fresh grass and plants were springing up on its sunny slopes; farmers were busy in ploughing and sowing their fields, and the snow had disappeared to such an extent on the sides of the mountains, that it was deemed practicable for our animals to subsist upon the dry grass of the previous year's growth.

The winter of 1853–'54 at Great Salt lake, from the middle of November to the 20th of January, was delightfully mild and open, and the fall of snow, which was light in the mountains, seldom extended into the valleys; but after the latter date the climate became much more severe, the temperature falling during the colder part of the day, for several successive days, below zero of Fahrenheit's thermometer, and storms became more frequent—snow falling in the plain to the depth of six or eight inches without drifts, while in the mountain plains and passes it exceeded a foot, and accumulated to great depths in the narrow ravines, and on the high slopes of the mountains, least exposed to the winds. In the vicinity of the city of the Great Salt Lake timber is confined almost exclusively to these ravines, which are difficult of access at all times, and become entirely inaccessible during the prevalence of deep snows, producing at once great scarcity of fuel in that city. The passage of the uninhabited mountain to the east, at such times, by the ordinary road leading over it, which, of course, is not kept open, is entirely impracticable; and the mail which passes monthly to and from Independence, Mo., is carried on pack-mules, which subsist themselves almost entirely on the grass along the route, by way of the Weber river cañon—the object in part of our present explorations, which will, however, be continued eastward to the valley of Green river.*

April 5.—On the afternoon of the fifth of April we reached the mouth of this cañon at the immediate base of the Wahsatch mountains, where it opens into the valley of Great Salt lake, thirty miles north of the city, and about seventeen from the mouth of the river, which we immediately crossed to its right bank. This river at this season of the year (not yet swollen by the melting snows of the mountains) is thirty yards wide, by from one to three feet in depth, flowing with a rapid, powerful current over a bed of water-worn stones and fallen rocks of all sizes, from pebbles to immense blocks of the adjacent mountain. Our altitude at this point was 73 feet above the city of Great Salt Lake, and 4,424 feet above the sea. Entering the pass, we at once left the usual low-water trail, which frequently crosses the river, and followed a precipitous and rocky path leading over the retreating craggy sides of the cañon, so steep that a single mis-step would have precipitated both mule and rider into the foaming torrent, hundreds of feet below us. At some points the precipitous sides of this passage become almost vertical. The mountains rise, we judged, from 1,500 to 2,500 feet above the river, and are separated at the base by a passage averaging 175 yards in width, in which the river winds from side to side, frequently impinging against the the bases of the mountains. At one point only, near the upper end of the gorge, which is four miles in length, the river is narrowed to one half its usual width, having cut a passage 20 or 30 feet in depth through the solid rock, which on the north side overhangs the stream, which, by a low projecting mass, is deflected from its course for a few yards at nearly a right angle, but again almost immediately resumes its direction; the cañon, as it is called—and at some points it well deserves the name—being remarkably direct in its general course. Above this gorge the mountain opens rapidly to the right and left, forming an immense oblong amphitheatre, the summits of the mountain peaks on opposite sides being separated by from 10 to 15 miles, while the river bottom, which is a plain, varies in width from half a mile to three miles. This is the finest grazing district we have seen in Utah, the bottom being covered with luxuriant grass which extends well up the mountain sides, to where they are at present covered with snow. The stream is skirted with poplar or cotton-wood trees and willow-bushes, and limited amounts of cedar, fir, and pine adorn the ravines and mountain sides, but are difficult of access. We encamped, after a march of 27 miles, at the junction of Ben Simons' creek with the Weber, where we found our Delaware guide, (after whom the creek is named,) with his brother and their respective squaws and little Indians encamped, with a small band of horses and herd of cows grazing near their lodges. These cattle appear in fine condition, having subsisted here through the entire winter by grazing alone. A much larger herd of cattle, on their way to the California market, which had been grazed in the vicinity of Fort Bridger during the early part of the winter, were subsequently driven here, where they remained for several weeks, having left but a day or two previous to our arrival. A considerable trade is carried on in cattle in and near the valley of Great Salt lake; its main profit arising from the exchange of cattle in good condition for those of emigrants broken down on their arrival here, compelling an exchange or a ruinous delay in their journey to California. The stock obtained by this traffic is turned out to graze during the winter; and although a few of the weakest and most emaciated die of cold, the great body of them come out in fine condition in the spring, and are sent forward to the California market, or form a new stock in trade for the ensuing season.

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* One of the most striking features to the traveller in our extensive and inhospitable interior country, after reaching the Rocky mountains from the east, in whatever direction he may travel in it, is the vast field of mountains which everywhere meets the eye. These mountains are sometimes formidable and united, their summits perpetually enveloped in snow, but more generally broken and disconnected, or partially united by projecting spurs or low connecting ridges, retaining snow but a portion of the year. They conform, with considerable exceptions, but not sufficient to impair its generality, in their greatest length to a general northern and southern direction, but frequently varying many degrees from the meridian. The great Rocky mountain range, by the line of our last and present years' explorations, consists, towards the east, of the Sierra Blanca range, in which are the passes of the Sangre de Cristo, and of Roubideau and Williams, united at the head of the San Luis valley with the Sierra San Juan; or at this point the range may be said to divide the two branches, under different names, extending far to the southward, enclosing the valley of the Rio Grande del Norte; the western or San Juan range eventually becoming the Sierra Madre of Mexico. Northward from the Sierra Blanca, the range is more or less broken by the valley of the Arkansas river, but preserves its general course, surmounted by Pike's and Janes' peaks, to the Cheyenne and Bridger's passes, and thence to the South Pass, where, nothwithstanding the great elevation of the country, its mountainous appearance is in a great measure lost, although the country is still very hilly and rolling, and in the distance high mountain peaks are ever visible. North of the South Pass, for some distance, the Rocky mountains again become lofty and again branch, sending out to the south a formidable range, known in various portions under different names, but generally as the Bear river and Wahsatch range, broken by the passage of Bear, Weber, Timpanogos, and Sevier river in their western course, but enclosing to the west the valley of Green river. Thus these three ranges, with their spurs and connecting ridges, form, on the line of our explorations, the main features of the Rocky mountains. But the country to the west is scarcely less mountainous; and as we become familiar with it in pursuing our explorations in various directions, it presents to our minds *one vast field of mountains*, interspersed with arid valleys from the Rocky mountains to the Sierra Nevada, and from the British possessions far southward into Mexico. The most extensive valley susceptible of cultivation in this whole extent of territory is that occupied by the Mormons, which is supplied with water for irrigation by the extensive fields of perpetual snow which are found on the mountain summits in their vicinity. And I may observe, generally, that fields of perpetual snow, affording an unfailing supply of water for irrigation, are an indispensable pre-requisite for their cultivation, and hence for their occupation, whatever may be the character of the soil of the valleys, in every portion of this territory in which I have travelled—a district extending from the northern boundary of Mexico to the waters of the Columbia river, and, by different routes, from New Mexico and the Arkansas river to the Sierra Nevada.

Our average ascent from the mouth of the cañon to camp, 7.80 miles, has been 53.50 feet per mile. The rocks in the gorge partake largely of the character of gneiss; but in descending the river with a railroad, no unusual difficulty would be encountered at this point, as the walls of the pass are sufficiently retreating to admit of its being carried at a suitable height above the stream to escape the danger of floods, and extensive blasting of rocks would be required only at a few points. Snows have formed no obstruction to its passage at any time during the past winter, nor, so far as I have been able to learn after much inquiry, do they at any time. In the valley, at our guide's camp, its greatest depth during the last winter was twelve inches, but seldom exceeded four, and for much of the winter was quite as free of it as the main valley of Salt lake. Our guide thinks a much more favorable emigrant road could be opened through this pass, ascending Ben Simons' creek to the vicinity of Green river, than that now followed over the mountains, which is still impassable from snow.

April 6.—We traversed the amphitheatre described yesterday, following the bottom lands along the Weber river to the foot of the second mountain and gorge of this stream, our ascent being 28.50 feet per mile for 12.20 miles, to Sheep Rock. The sides of this gorge are less precipitous than those of the lower, and the bottom or passage in which the river winds is frequently much wider, while the mountains are of nearly the same altitudes with those, but much more broken by ravines. The bottom, too, is less firm, being frequently miry, and numerous small channels into which the river is divided are dammed by beaver—green trees of six inches in diameter having just been cut down by these animals for their damming purposes—making part of it a swamp, miles of which are covered with thick willows, where the soil is too soft for a good wagon road without carrying it on an artificial bed, which can be easily made along the base of the mountains. The river winds so much that we were forced to cross it sixteen times, the water being icy cold. We encamped on Dry creek, which enters the river at the head of the gorge, eight and a half miles from Sheep Rock, from which we ascended 27 feet to the mile. In constructing a railroad through this defile, it will be necessary to bridge the stream several times, which can be readily done; but for the most part the road would be carried immediately at the base of the mountains, where it can be constructed with facility by cutting along their sides and filling in at their bases. These bases are formed of earth and loose stones overlying strata of shale, limestone, conglomerate, and argillaceous sandstone, dipping at every angle, and in almost all eastern directions from south to north; and in a few instances strata bent (before induration) were seen; and in one, vertical, parallel, walled dikes intersect the northern slope of a mountain near the head of the passage, extending from the water's edge to near the summit of the mountain, only separated by about ten feet, and rising thirty feet above the mountain slope.

April 7.—A cold rain, which continued to fall throughout the night, poured down upon us as we wrapped ourselves in our blankets last evening; and as we were without tents or other protection from the weather, but little sleep refreshed the party; and at 9 o'clock this morning the rain changed to snow, (which had been falling all night on the high peaks in the mountains,) and continued to fall heavily throughout the day, melting as it reached the ground.

Above the junction of Dry creek with the Weber river, the latter comes from the south, cutting through a red conglomerate sandstone mountain six or eight hundred feet high, which is rapidly disintegrating, the talus at some points being entirely swept away by the river, and at all others it stands at too steep an angle towards the water to be easily climbed over.

The Indian trail, however, passes through this cañon at low water, a part of the way in the stream. It is five hundred yards long. We rode to its upper end and clambered in to examine it. The trail by which we passed ascends Dry creek half a mile, and then passes without difficulty to its head, by a low pass in the ridge through which the cañon itself is cut. This is the proper site, also, for a railroad. Above this cañon a considerable valley extends south to the Kamas prairie. This valley varies in width from three or four miles to a few hundred yards, and is drained by the Weber river, having on its margins considerable bottom lands, which at this season of the year are quite wet, and in many parts are covered by cotton-wood trees and willow-bushes. Ascending this valley we came to the emigrant road leading from the South Pass to Great Salt lake, which we followed to the mouth of Echo cañon, where we left it and continued up the river to the mouth of White Clay creek (Moran's fork.) The mountains on the left of the valley, as we ascended it, are conglomerate sandstone, full of cavities numerously inhabited by ravens. The snow was falling so fast that we were unable to see a hundred yards, and were obliged to dismount and wait for it to diminish; when we again remounted, and, turning east, left the Weber river to ascend White Clay creek and pass over to Bear and Green rivers. The valley of our path after leaving the Weber was from one-half to three-fourths of a mile in width, finely covered with dry and green grass, the hills being covered with a stunted growth of cedar, and cotton-wood and willows line the stream, which has upon it little or no bottom land. The storm ceased as we encamped, having travelled but 10.50 miles, with an average ascent of 16.50 feet per mile.

April 8.—A piercing cold wind sprang up during last night, the thermometer falling to 27°, and continued all day blowing from E.N.E. directly in our faces as we ascended White Clay creek, which is one foot in depth and five in width, with a free rapid current. Its narrow bottom is from one to two hundred yards in width, with low spurs of hills occasionally extending to the stream. It is lined with cotton-wood and willows in the lower part of its course, but is quite destitute of timber higher up, while scattered cedars are seen on the nearest hills, and pine, fir, and aspen fill the ravines of the mountains, the highest peaks of which are 14 miles south of us on the northern bank of Weber river, whence it descends from the east to Kamas prairie. Numerous tracks of grizzly bears and porcupines were seen in the snow, beaver dams and lodges in the creek bottoms, and a fine silver-gray fox watched our progress for some time from a high hill, safely beyond gun-shot. Fourteen miles out we came into continuous fields of snow, six inches in depth, except on the southern exposures, where it had almost entirely disappeared. Its surface was hard and stiff, though not strong enough to bear either men or animals, and as we broke through at every step, our progress was tedious and fatiguing; and these were greatly increased whenever we had to pass slight inequalities in the ground filled with snow, and the narrow drifts always accumulated on the northeastern declivities of the hills—our mules literally rolling, pitching, tumbling, and floundering through. Thermometer at noon 38°. For the benefit of our animals, we ascended the side of a hill, where the snow had disappeared, on a branch of White Clay creek coming in from the southeast, and encamped just before sundown on a soft, muddy soil, sprinkled with dry grass. The Uinta mountains, whose general course is apparently nearly due east and west, have been plainly in sight for the last two days, some 25 miles south of our path, with numerous high peaks covered with vast fields of snow from the lowest points visible on them to their summits, the sources of the Uinta, Timpanogos, Weber, and Bear rivers, and of Black's fork, and numerous smaller streams. From the northern foot of this range to our path, a level, timbered terrace country extends, called, in the Sho-sho-nee or Snake language, Yaw-ning-got-it, or Porcupine terrace; from the west it extends from the sources of the White Clay creek, (To-sho-sho-coop, in the Snake tongue,) across Bear river, the Muddy and Black's fork, broken only by a few low detached hills and the ravines of the water-courses. Its timber, pine and fir, is abundant, and of a suitable size for bridges and building purposes.

For the first ten miles this morning our ascent averaged 84.20 feet per mile, and 54.20 feet per mile for the following 8.75 miles, to the junction of the branch on which we encamped, with White Clay creek.

April 9. A bright clear morning; thermometer at daylight 21° below the freezing-point. We returned to White Clay creek, striking it near its head, by passing over the hill on which we had encamped, a distance of 11.50 miles, by the windings of that stream, from the junction of the branch where we left it to encamp, which we examined in repassing this point on our return trip on the 18th instant. This creek preserves its open character, with easy, gentle curves, to its source, the grade averaging 41.80 feet per mile, and the country becoming more level and open as we ascend. We were here upon the divide between the waters of Weber and Bear rivers, immediately overlooking the latter stream a mile and a half distant and but a few feet below us, our altitude being 7,491 feet above the sea.

We immediately descended to the first channel of Bear river, which is forty feet wide and one deep, with a firm bed, crossed without difficulty to a large level plain, four or five miles wide by ten or twelve in length, extending southward to the foot of Porcupine terrace, through which the river winds in a narrow ravine. The snow upon this plain was from six to ten inches in depth—hard and stiff, but not sufficiently so to bear our animals—with pools of water and soft ground beneath it, affording no firm footing, and our progress was consequently very laborious. The sun was very bright, and its powerful reflection from the snow very severe upon our eyes. Three miles from the first we crossed the second channel of Bear river, a small stream four feet wide, beyond which we rose a bluff 12 or 15 feet high, to a second plain extending to our camp on Sulphur creek, which descends in a small ravine from the terrace above. Altitude, 7,494 feet.

April 10.—A light snow begun to fall during last night, and continued all day, with a high, driving wind, which rendered our progress very disagreeable; and nearly one half the officers and men of the party were so snow-blind as to be unable to see beyond a few feet, and suffered intense pain from their inflamed eyes, the lids of which were swollen to a dropsical appearance, while their faces were quite as badly inflamed, skinned, and intensely sore. We crossed a small stream running into Bear river, four miles from our morning camp, and afterwards three small branches, which unite and form the Little Muddy, and encamped on the main creek of that name, after a march of only 11.20 miles. Our altitude on the divide, between Bear river and the Muddy, an affluent of Black's fork, which flows into Green river, and consequently upon what is called the eastern rim of the Great Basin, was 8,133 feet, and at our camp this evening 7,779 feet above the sea.

We encountered but little snow on the high surfaces and western slopes of the hills to-day, but invariably found large drifts just below the crests of the northeastern slopes, occasionally so compact as to bear our animals, but generally giving way under their feet.

April 11.—Thermometer at 5 a. m., 26°. Soon after leaving camp we crossed a small branch of the Muddy, and then ascended the ridge setting down from the Porcupine terrace, and nearly on a level with it, between the Muddy and Black's fork. This ridge preserves its elevation for several miles to the north, and then subsides abruptly into the valley of the fork. Upon this divide we encountered much more snow than upon any other part of the route, for the warmth of the season was not yet sufficient to affect it at all; and its average depth was from twelve to sixteen inches, while the drifts were broader and deeper than we had before encountered, varying from fifty and a hundred yards to a fourth of a mile in width. These banks, as before stated, are always found just below the northeastern crests of hills and ridges, and can only be avoided by passing either above or below them.

The view from this position is very extensive. Overlooking the immense valley of Green river, which sweeps off to the east, apparently in an almost uninterrupted plain, the Sweet Water mountains near the South Pass, with the positions of the Muddy and Bitter creeks descending from them, are plainly in sight; and to the south the sources of Black's, Smith's, and Henry's forks, in the Uinta mountains.

From the head of White Clay creek, eastward for 19 miles, a railroad should be carried on a gentle curve to the southward, (as indicated on the accompanying map) along the Porcupine terrace before described, crossing Bear river and the main branches of Muddy and Sulphur creeks, where they are narrow ravines, offering no serious obstacles in themselves to its easy construction; thus avoiding any but a local descent in the passage of these streams, and turning all the smaller ravines and branches which must otherwise be crossed below.

The ascending grade upon this line will be 49.8 feet per mile for 12.90 miles, and 39.50 feet per mile for 6.10 miles; and the altitude of the point thus gained—the highest upon the line—8,373 feet above the sea. And in descending from this point, the road should follow the ridge or divide west of the main branch of Black's fork by a uniform grade, to which there is no obstruction, of 40.30 feet per mile for 12.25 miles, to the main open valley of the fork, to which we descended at 10'clock a. m. The level valley of this stream is here three miles in width, with pine, white cedar, and aspen growing upon the stream, and extending to and uniting with that on the base of the Uinta mountains. We found considerable grass in this valley, and mud in place of snow. The stream in the present low stage of the water, the snow not having commenced to melt in the high mountains, is but 12 feet wide and eight inches deep, flowing rapidly over a bed of stones. In crossing its bottom we rode for some distance on the remains of a beaver dam, precisely resembling a small embankment 18 inches high, thrown up in making a common ditch. It is several hundred yards long. Travelling partly parallel to the stream, we crossed over to Smith's fork, which is separated from Black's only by a plain common to them both, passing near a settlement called Fort Supply, commenced on Smith's fork last autumn. It consists of only a half dozen log-houses, and although the margins of the stream are finely grassed—upon which considerable herds of cattle have been successfully grazed during the past winter, with no other food or shelter than they could themselves procure—it must be regarded as a doubtful experiment, until experience shall have established the practicability, in this latitude upon our continent, of producing crops during the cold summers, and grazing cattle during the severe winters, incident to so great an elevation—7,254 feet, that of our camp on the stream, two or three miles below the fort. Our descent from where we came upon Black's fork to camp, nine miles, was 69.50 feet per mile.

We were here in the immediate vicinity of Fort Bridger, the position of which a few miles to the north, on Black's fork of Green river, was plainly in sight across the open plain. In descending from the head of the Muddy I have given the preference to the line indicated, over that which follows that stream, as it is entirely free from short curves; and the valley of Black's fork, above the junction of the Muddy, is much more broad, open and direct than that of the latter stream. The line eastward from our present camp should be continued directly to where it should cross Green river, near the mouth of Black's fork, and be continued thence eastward by the line followed by Captain Stansbury from Green river, by way of Bridger's Pass, to the

Great Plains, in 1850, as reported by him in his expedition to the Great Salt lake, and thence descend by the South fork and main Platte, or pass over to the Republican fork of the Kansas, and descend it to connect at a suitable point with eastern lines of commerce.

April 12.—It began to snow at dark last evening, and continued without intermission until late this afternoon. Several of the party were still suffering severely from snow-blindness, and many of our animals were becoming weak and exhausted for want of sufficient nourishment. I determined, therefore, to leave a portion of the party in camp on Smith's fork with the weakest animals, and to proceed with the balance to Henry's fork of Green river, a route represented to possess superior advantages to that before indicated for a railroad, to the east from Smith's fork. With Captain Morris, Mr. Egloffstein, and Mr. Snyder, and a small escort, and with our Delaware guide, I started—the snow being four inches deep as we left camp, and falling so fast that we could not see beyond a few hundred yards, but fortunately the storm was in our backs—bearing a little to the southeast to avoid the mud of the plains, which were very slippery and soft. We travelled over a succession of low hills, and crossed two or three small branches of Smith's fork, coming to Cottonwood creek at 1 o'clock, p. m., where our altitude varied but nine feet from our morning camp. We here came upon a wagon road leading from Fort Bridger to Henry's fork by a low pass in the small mountain spur dividing the waters of that stream and of Cottonwood creek. It is six miles from the creek to the summit of the pass, and the difference of level 266 feet. Entered from the north it is narrow and direct, and is formed of horizontal strata of clay, from six to fifty feet thick, often separated by thin strata of sandstone; and the clay itself in some parts is indurated to an argillaceous stone containing considerable sand. It is washed into a thousand gullies and ravines, and its slopes are barren. The spur itself is level upon its summit, and preserved from washing by a capping of stone.

Notwithstanding the storm, our guide related an incident which occurred to him a few years since in this pass, characteristic of the adventuresomeness of his own tribe, and of the war habits of his race.

He was travelling this pass at midnight, accompanied by his squaw only, both mounted upon the same horse, and the night so dark that he could neither see the outlines of the hills nor the ground at his horse's feet, when he heard a sound, (which he imitated) so slight as scarcely to be perceptible to an Indian's ear, of an arrow carried in the hand striking once only with a slight tick against a bow. Stopping, he could hear nothing, but instantly dismounted, his squaw leaning down upon the horse that she might by no possibility be seen, and placed his ear to the ground, when he heard the same sound repeated, but a few feet distant, and was therefore satisfied that, however imminent the danger, he had not yet been heard or seen, for no Indian would make such a noise at night in approaching his foe; he therefore instantly arose and took his horse by the bridle close to his mouth, to lessen the chances of his moving or whinnying, and one hundred and seventy of his deadly enemies, the Sioux, on a war party, filed past him within arm's reach, while he remained unobserved.

We encamped on Henry's fork after a ride of 23.50 miles, descending for 3.20 miles, from the summit of the pass, 122 feet to the mile. The valley of this stream is of the park-form, ten miles in diameter at our camp, with bottom lands from one to three miles in width, narrowing rapidly as it descends. The bottom is finely grassed, while the hills about it are barren or covered with artemisia; but the mountains to the south are quite covered with pine. The water of the stream flows in several channels through the meadow, which might be easily irrigated, and support a small settlement, if not too cold for cereals.

April 13.—Leaving half of our men in camp, we descended the valley, crossing several little streams, the largest of which is called Dry Timber creek, and seven miles below camp bore off to the right, and ascended a high point of the adjacent mountain to obtain an extensive view of Green river and of the surrounding country. The snow, scarcely two inches deep in the valley, soon increased to a foot and more, and our animals waded heavily through the deep drifts and gullies. We were rewarded, however, for the labor of the ascent by the excellent view obtained.

The valley of Henry's fork continues its uniform descent to its junction with Green river, fifteen miles distant, and immediately to the south of it two other small streams enter Green river from the west, separated by a pile of rocks called the Beaver Lodge, which is also the name of the northern stream; the southern being known as Medicine Spring creek by the Indians, and Blue by the trappers, from a fine spring somewhere near its source. Fifty miles distant the Uinta mountains were seen, terminated to the east by the passage of Green river, and through a large gap in an intervening range the pine-covered sides of Brown's Hole were distinctly visible. Above the mouth of Henry's fork stand two isolated buttes of the same altitude as the low range, to the north of this stream, which we crossed yesterday, and of which they once formed a part. Green river descends from the north just to the east of these buttes. Beyond this river, to the north and east of Brown's Hole, high ranges of mountains, covered with snow, extend far to the east and to the south of the line indicated for the railroad from our camp on Smith's fork. So far as this proposed line can be seen from this point—which it can be far east of Green river—it appears very level. But the wind whistled cold and piercing about our heads, and, standing knee-deep in snow, we were soon chilled through, and, hastening our notes and observations to a close, descended in an hour and a half to Henry's fork, to a comparative summer climate—a change from 34° to 50°—the snow having entirely disappeared from the valley during our short absence.

Notwithstanding the severe snow-storm yesterday, the party suffered quite as much from blindness as during a bright sunny day, my own face becoming somewhat inflamed for the first time, and "Ring," a bulldog which accompanied us, became so much affected that he could not be induced, in camp, to open his eyes, from which tears were constantly falling. We returned at evening to our morning camp.

April 14.—We repassed the divide by which we entered the valley of Henry's fork. From Cottonwood creek, we followed a line across the artemisia plains or mesas, a little to the north of that followed in our outward journey. The light and friable soil of these plains is now saturated with water, from melting snow, and is miry and slippery. They are terminated to the west by abrupt bluffs of clay, so steep and slippery, that, in descending them, we were obliged to dismount, and let our mules slide down as they best could—ten and twenty feet at a time. They decline rapidly to the north, and, apparently, soon entirely disappear in that direction. Grass is confined to the borders of the water-courses, the intermediate spurs being occupied by fields of artemisia. We encamped at evening on Smith's fork, a short distance below our camp of the 11th instant, and on the following morning (April 15) continued our western course, recrossing Black's fork and the ridge separating it from the Muddy, on which we encamped a little above the emigrant road to Great Salt lake. Although the valley of this stream is not so broad and direct as that of Black's fork, a railroad could readily ascend it to intersect our outward line at its crossing; but, as before stated, the line then indicated would probably be preferable.

April 16.—The country over which we passed to-day is very elevated and dry, and the vegetation principally confined to artemisia. It overlooks our outward path to the south, which preserves its superior appearance even from this distance. We encamped on Bear river, about which the snow had nearly disappeared. The grass has not yet sprouted, however, for a new growth, and our animals fare badly on that which has been buried under the snow from last year, and is now soaked from its melting.

April 17.—We returned to the head of White Clay creek this morning, and descended it, encamping two miles below its Beaver branch junction, when we again returned to fields of fresh grass. High up on the sheltered faces of a few bluff rocks, cropping out on the southern bank of the creek, as we descended it, large numbers of nests of clay, in clusters of pine-apple size and form, were seen, which our Delaware guide says are built by a dark-colored bug, which is good to eat when boiled. I could obtain no specimens of them. The guide killed a fine elk near camp.

April 18.—We attempted to-day to find a more direct route to the Kamas prairie and Timpanogos river than that by the mouth of White Clay creek and Weber river. In leaving camp, we ascended a narrow ridge, and again almost immediately descended its opposite slope, and crossed a small creek, beyond which, in ascending the succeeding hill, we entered upon a field of snow, two feet in depth, which was too soft to bear our animals, and was filled with brush and concealed fallen-timber, rendering its passage for a mile a severe labor; and several smaller fields were passed in crossing a broken country, until 11 o'clock, when we were rising a high ridge, and expected, at its summit, to find an end to our snowy labors, and to descend with comparative comfort to the prairie; but the snow had driven us off the summer trail, and, as we rose to the summit, we were greeted by the sight of another formidable ridge, everywhere presenting one immense field of snow apparently impassable, and the guide came to a stand—his last horse had failed. I however examined the country attentively, mounted the guide on a mule, and determined to go on, and in two hours, by severe labor, reached the succeeding summit; but, instead of seeing an end to our labors, and refreshing fields of grass at our feet for our exhausted stock, we saw before us only a precipitous descent of half a mile, followed by an ascent still steeper and higher than the former, which we accomplished, with increased labor, however, only to find before us an impassable field of snow, extending down the face of the mountain for several miles to Weber river. Our altitude was here 8,619 feet above the sea, and a magnificent view of the country in some degree rewarded the labor of the ascent. North, south, east, and west, the country presented only one extensive field of broken mountains. The opening made in the Wahsatch mountains by the Timpanogos cañon, with a high intervening peak or two between us and Kamas prairie, looked favorable for our passage; the high, snowy range between us and Great Salt lake, as far north as Weber cañon and Ogden Hole, was also before us, with those to the east crossed by the emigrant road. Above us, the Weber descends through an extensive mountain district, at present covered with impassable snows, and surmounted to the south by the higher and still more snowy peaks of the Uinta range.

Pine covers the steep mountain sides south of the Weber. We encamped on this summit, and sent out the guide with a party on foot to find, if possible, a practicable descent; he returned at dark with an unfavorable report, however, unless the snow should freeze during the night strong enough to bear our animals, of which there is no prospect.

April 19.—It began to rain during the latter part of last night, and the mountain sides at daylight were sending down rivulets of snow-water from every point. We were, therefore, reluctantly obliged to turn back, following, through banks of snow for two miles, the course of a small branch of White Clay creek, lying between high, steep hills and spurs of mountains. The heavy, cold rain from the southwest increased as the morning advanced, falling uninterruptedly for five or six hours, until we had gained a more open country as we approached White Clay creek. At every step, after leaving the snow, in this rapid descent, we were passing fine fields of grass, extending from the ravines to the mountain tops. We had certainly been driven higher up the mountains in our attempt to effect this passage than would have been necessary but for the snow; but it is not too much to say that there is no practicable route for a wagon-road, and much less for a railroad, by this Indian trail from White Clay creek to Kamas prairie, although it is the best in the vicinity, except that to which we returned. Soon after reaching White Clay creek, we passed our camp of the 7th instant, and again entered the valley of Weber river, in which we encamped, in the midst of luxuriant fields of fresh grass, 5.25 miles from the camp of the 7th.

In descending the mountain to-day, we passed a few out-cropping ledges of conglomerate rocks and sandstone, but soil and earth covered almost the entire surface of the mountains and ravines. The sun shone bright and clear during the afternoon, and dried our drenched clothes. The accompanying sections of the routes explored by the Weber and Timpanogos cañones, branch at our camp of the 7th instant on White Clay creek, the former descending the Weber, and the latter ascending it.

April 20.—The wind, which had changed to northwest during the afternoon yesterday, returned to southwest last night, and the morning came in with a gentle cold rain, which increased during the day to heavy showers at short intervals. The width of the Weber valley, within the low hills, between our morning camp and Kamas prairie, varies from two or three miles to a few hundred yards; but we soon passed above the altitude of green grass, although the whole face of the country was covered with the growth of last year. It was 12 miles to Kamas prairie, which is five or six miles wide by eight and seven-tenths miles in length, and, to the eye, is as level as a sheet of water. The Weber river descends to it from the east, flows across its northern end, and thence descends to Great Salt lake, by our ascending path. A stream, ten or 12 feet wide, winds through the prairie, entering Weber river at the northwest angle of the meadow. It is seen descending from a mountain ravine on the east side of the plain, six miles distant. A mile to the south of this ravine is the divide between the Weber and Timpanogos rivers—if so slight a change of level deserves the name of divide—the latter flowing at the base of a snowy range of mountains terminating the prairie to the south. We attempted to ride directly across the prairie, but found it so miry that we were obliged to turn back and keep along the base of the hills to the west, reaching the Timpanogos where it leaves the prairie. The average grade from our camp of April 7, on White Clay creek, to our morning's camp, 5.25 miles, was 3.80 feet per mile; and 53.90 feet per mile for 12 miles thence to Kamas prairie; and across the prairie to Timpanogos river, 8.70 miles, 8.80 feet per mile—the altitude of the prairie at Weber river being 6,319 feet above the sea. Below the prairie the Timpanogos river descends in a bottom varying from 100 to 250 yards in width, covered by cotton-wood. It is enclosed on the south by mountains, and on the north by high walls of a coarse feldspathic granite, from one to two hundred feet high. The stream is twenty-five feet wide, with a rapid current. This bottom is entirely free from snow, and sufficiently wide and elevated above the river to admit of an easy construction of a railroad.

We encamped some two miles from the prairie and river, on its right bank, among the hills.

April 21.—It continued to rain during the whole of last night, and this morning snow was mixed with the falling rain; but after being two or three hours on the road, we passed below the storm, which continued about the higher mountain peaks throughout the day. We returned to the Timpanogos river at the lowest point on it visible to us from Kamas prairie last evening, its valley being here half a mile wide, and, for three miles, very miry from the great amount of rain recently fallen upon it, and covered with willows. We therefore kept along the base of the hills, and occasionally passed over considerable spurs extending into the valley. Below this the stream enters a broad open valley, several miles in diameter, called Round prairie, in which it receives small tributaries from the east and south. In this prairie the grazing is very fine; and the valleys and mountain sides along our path, throughout the day, were covered with the finest fresh grass from an inch in height at our morning camp, to eight inches at that of this evening. In the prairie the stream bends more to the west, and preserves this course, as the valley narrows to a few hundred yards in width as we approached the eastern base of the narrow Wahsatch chain. Entering the mountain, the valley becomes still more narrow, and in a short distance quite disappears, and the passage becomes a formidable cañon, in which the general course of the river is very direct; but the hills or mountain spurs, which extend down to it, slightly overlap each other, giving it a zigzag line upon a small scale, the projecting points overlapping but a few feet, and are generally not high. The southern bank is much the most abrupt, the wall becoming so nearly vertical as to be inaccessible. The rock at the base is chiefly a hard blue limestone, capped towards the summit of the mountain, with a stratum of argillaceous sandstone of great thickness. On the north side of the river, the mountain is terminated more in stages; yet it is very abrupt, and we had some difficulty at times in following the Indian trail along its face, in its natural state. These rocky precipices, rising one above the other, soon gain an elevation of two and three thousand feet, and the highest points finally attain an altitude of 4,000 feet above the river. The dip of the stratified rocks, wherever they are exposed, is from the river, and consequently there is little danger of land-slides in this gorge. The river as it enters the cañon is thirty yards wide, flowing with a strong current; but towards the foot it becomes still more rapid, breaking with considerable noise over the rocks in its bed. The pass, which is ten miles in length, varies in width from one hundred to three hundred yards; and in constructing a railroad through it it would be necessary to cross the stream several times, to avoid short curves, which could be done as easily as bridges are usually built; and considerable blasting of rocks would be requisite at various points, but amounting to no large aggregate. A little pine grows on the mountain sides quite down to the river, but it seldom exceeds 8 or 10 inches in diameter.

The descent per mile for the first 5.70 miles from Kamas prairie, is 32.90 feet, and 60.90 feet to the mile for the next 5.20 miles; for the succeeding five miles it is 44.40 feet per mile, and six feet to the mile for the succeeding 5.40 miles; and for three miles from the head of the cañon the average descent is 30.10 feet per mile; and for the succeeding eight miles, to our camp below the cañon, 39.60 feet per mile. Our altitude at this camp was 5,077 feet above the sea, and 150 feet above the river.

April 22.—We descended the river a short distance this morning, and then turned around the base of the mountain northward into the valley of Utah lake, which lay beautifully bright below us. A railroad from the Timpanogos cañon should follow the same line, gradually descending into the valley and passing through its numerous Mormon settlements to the foot of Utah lake, where it should cross the Jordan, and, if practicable, cross the Oquirrh mountain through Cedar valley to the west of Lake Utah—the appearance of this part of the mountain, seen at considerable distances both from the east and the west, rendering it worthy of examination, if at any time a railway shall be constructed west from Timpanogos river; but if this route should be impracticable, then it should descend the valley of Great Salt lake to the north end of Oquirrh mountain. The descending grades by the latter line will be 33.80 feet per mile for 14.20 miles, from the foot of the cañon to the American fork; and 3.50 feet per mile for 39.60 miles thence to our camp of the 6th of May, at the northwestern angle of the valley of the Jordan. This unobstructed valley, of 20 miles in width by 30 in length, is largely susceptible of irrigation and cultivation, and already contains many Mormon settlements, of which Great Salt Lake City is the principal.

It began to rain violently at 2 o'clock p. m., and continued until dark, soon after which I arrived at Great Salt Lake City after a ride of fifty miles. Latitude 40° 45′ 37″.

CHAPTER II.

From Great Salt Lake City to the valley of Humboldt river—May 1 *to* 23, 1854.

Receipt of orders.—Explorations performed in anticipation of the receipt of these orders, and extract therefrom.—Leaving Salt Lake City.—Valley of the Jordan.—Grass and springs.—Railroad line by the south end of Great Salt Lake.—Snowstorm.—Scenery in entering Tuilla valley.—Mormon settlements.—Old shore-line.—Formidable pass—Goshoot Indians.—Indian guides—Salt and warm springs.—Character of rocks.—Water driven over marshes of the lake.—Birds.—Springs in conglomerate rocks.—Fish.—Spring or Lone Rock valley.—Frémont's route of 1845, and Stansbury's of 1849.—Railroad route.—Gophers and grass-seed as Indian food.—Passage of Cedar mountains.—Scarcity of water.—Pass not suitable for a railway.—The Desert to Granite mountains and Fish springs.—Storms.—Mirage.—Railroad route to the south and west of Pilot Peak.—Miserable condition of Goshoot Indians.—Examination of first range of Goshoot mountains.—Rock; grass; timber.—Fish creek.—Railroad route.—Shoshonee Indians.—Striking contrast between the Shoshonees and Diggers, (Goshoots).—Passage of successive ranges of Goshoot mountains.—Vegetation and rocks.—Gate of Narrow Pass.—Rain; hail; springs.—Wretched condition of Indians.—Frost.—Goshoot lake.—Digger wick-ey-up and its occupants.—Digger language.—Topographical sketches of railroad line *via* Pilot Peak.—Franklin River valley; its lakes, rivers, and vegetation.—Old lake-shore.—Hastings's road.—Route for packing-parties.—Pilot Peak railroad line.—Remarkable formation of the basin.—Humboldt Mountain railroad pass.—Country as seen to the west of this pass.—Snow in the pass.—Rocks in the pass.—Valley of the Humboldt, by Colonel Frémont.

May 1.—I received on the first of May, at Great Salt Lake City, your orders of the 21st of February preceding, directing me to make the explorations and surveys of the passes eastward from the Great Basin embraced in the preceding part of this report—these surveys having been made in anticipation of the receipt of the instructions referred to, or, in case of their non-arrival, to facilitate the completion of the explorations already ordered—and then to retrace my steps and survey the route which I had proposed, "passing to the south of Great Salt lake in the direction of the 'Sink' of Humboldt or Mary's river, thence towards Mud lake and across to the tributaries of Feather river, and thence by the most practicable route to the valley of the Sacramento river."

May 5.—Leaving Great Salt Lake City, we encamped on the west side of the Jordan, which is now flowing with a muddy, turbid current, considerably swelled by melting snow.

May 6.—The wind blew heavily during the latter part of last night, and a slight fall of rain renewed with vigorous freshness our previous realizations of camp life; and slight showers rapidly succeeded each other, crossing the valley of the Jordan from southwest to northeast during the day. At this season this valley is supplied with a growth of green grass which occasionally forms a sward, but is generally thinly scattered over the surface among the varieties of artemisia known as sage and greasewood. In crossing the level valley from the Jordan, the road is now very good; but during the rainy seasons there are a few miry alkaline beds, which are for the most part, however, easily avoided by making a short circuit to the right or left. We ascended slightly the base of the Oquirrh mountain, and encamped in abundant fields of grass. Large springs burst out along the northern base of this mountain near the Great Salt lake, but are generally more or less brackish; yet the water is used by the few Mormon families settled about them. Day's march, 12.98 miles; altitude, 306 feet above Great Salt Lake City. In constructing a railroad, however, this altitude is entirely unnecessary, as the road can be carried nearly on a level with the water of the lake, without a material change of grade while in its vicinity. It is at this point that a road descending the Timpanogos river, and passing by the north end of Lake Utah, should intersect one descending by the Weber, and passing to the south of Great Salt lake, unless it shall be found practicable by the former line to pass the Oquirrh mountain through Cedar valley.

May 7.—A disagreeable night was followed by a high wind and a heavy snow-storm from the northwest, which drove in our faces for two hours while we were passing around the north end of Oquirrh mountain to Tuilla valley. The scenery in turning this point, in the storm, where we came directly upon the shore of the lake, with several islands rising abruptly from its waters, with high mountain shores and extensive mountain ranges in every direction, was very beautiful, and caused regret at the taste displayed in the selection of the site for the neighboring city, from which this beautiful sheet of water is seldom visible, and never appears picturesque. But as it is a city of farms, necessity doubtless dictated its own terms.

The Mormons have several small settlements in Tuilla valley, which is ten or twelve miles in width, and extends south from the lake for some twenty miles, where it is crossed by a cross-range with low depressions at either end; the eastern leading into Cedar valley, and the western along the eastern base of the high range forming the western limit of this valley. The eastern side of this valley is finely grassed, but in crossing it the road lies through a continuous artemisia field, more or less interspersed with grass. For five or six miles in crossing, our road lay along an old shore-line of the lake, elevated some twenty feet above the general level of the valley, into which it gently subsides near a fine spring of water, flowing off in a bold little stream towards the lake. We encamped, after a march of 20.59 miles, on Willow creek, three and a half miles above or south of the most western Mormon settlement upon this line, and directly at the foot of what had been favorably represented to us as a pass by which to cross the mountain. But its appearance as we approached it was too formidable to require further examination; and the Indians who came to our camp informed us, that it is with the greatest difficulty that a horse when led can ascend by this trail when free from snow—which it is not now—and that with a rider it is impassable. Altitude of camp, 4,487 feet above the sea, and 170 feet less than at our morning camp.

Sho-ish, a Utah chief, had sent a runner to his neighboring band, the Goshoots, upon whose territory we were just entering, to say that I was his friend and made very fine presents to his Indian brethren, who accordingly presented themselves at our camp, and were delighted with the trinkets which they received; and I employed two or three of them to accompany me across their own deserts and mountains, no reward being large enough to tempt them to introduce us to their western neighbors, of whom they stand in great fear. Snow-squalls continued during the day, whitening the valleys to the water-level of the lake, and ice formed during the night.

May 8.—After some slight examinations of the mountains to the south, we turned down Willow creek, and passed north along the base of the mountain towards Great Salt lake, passing several saltish springs and one warm spring, and encamped opposite Stansbury's island, 13.70 miles from our morning camp, and 4,238 feet above the sea. The rocks of the Oquirrh mountain, near Black Rock, and those near our present camp, are conglomerate and sandstone, with others changed (metamorphic) by igneous action, standing in nearly vertical planes. Ducks, gulls, and snipe of a large species, were killed in considerable numbers about our camp, and mosquitoes and gnats were very troublesome. The driving of the water, by the wind, upon the nearly level marshes which border Great Salt lake, presents a marked resemblance to a flowing tide, which has its counterpart in the ebb at the falling wind.

May 9.—Before passing around the north point of the mountain, three miles from camp, into Spring or Lone Rock valley, we passed several salt springs, one of which was blood-warm, sending out a fine stream of water beautifully clear at its source, at which gas was constantly bubbling out; and, as we entered the valley, these springs became more numerous—the finest of which sent out a volume of water two feet in width by three inches in depth. This spring issues through a mass of conglomerate rock, and is inhabited by a multitude of small fish two or three inches in length, which retreated into the spring under the rocks at my approach. Several other springs, as we passed on, were far less salt, but our horses drank of them reluctantly. Our path led all day through fine fields of grass, which sometimes occupied the surface unopposed by more hardy plants, but at others was thickly interspersed with artemisia, of the greasewood and rabbit-bush varieties. The large central portion of this valley towards the lake, is an alkaline plain, too soft and miry to be conveniently crossed. It is terminated to the west by Cedar mountains, a range parallel with, but not so elevated as that to the east of the valley, which is twenty miles wide. We encamped, after a march of 21.45 miles, on a fine litle creek a foot in width, descending clear and cold from the highest snow-peaks of the range to the east. It would serve to irrigate a few farms before reaching the alkaline bed just mentioned, in which it sinks. High up the mountain peaks above our camp a few dark masses of pine are seen, and cedar extends nearly down to the valley. Our camp is a short distance south of the line by which Colonel Frémont crossed this valley in 1845, and Captain Stansbury in 1849, and by which it should be crossed by a railway to Cedar mountain, which should be crossed by the route followed by Frémont, where the altitude of its summit is given on the map "drawn by Mr. Charles Preuss from the surveys of Colonel Frémont and other authorities, under an order of the Senate, in 1848," at 5,009 feet above the sea, or about 800 feet above Great Salt lake, or by lower depressions still further to the north, if it should be found desirable. In its course west from this mountain, it should be carried as far as practicable to the south, without unduly increasing its length, to avoid the miry plains nearer the lake—these plains becoming firm in proportion to their distance from it—passing by one of the open spaces to the south of Pilot Peak, by which the succeeding chain of mountains to the west is terminated to the south, and thence be continued by the north end of the succeeding western range towards the head of Humboldt river. For a faithful and lucid description of this part of the line, I beg to refer you to Captain Stansbury's report of his expedition to the Great Salt lake, chapter vi, pages 111 to 116; and for its delineations, to the map before referred to, made by Mr. Preuss. The passes and the country delineated by him in that vicinity were observed with much attention by us from the line which we explored a little to the south of it, our observations confirming the general character of the country as represented on this map, but materially adding to the positive knowledge of it, as will be seen by reference to the accompanying map. We crossed this desert on the 12th and 13th instant, under which dates its description will be found.

May 10.—By the advice of our Indian guides, we crossed Lone Rock valley by a very direct course to the pass in Cedar mountains, which they represent as leading to the best route by which the desert west of it can be crossed—the pass itself, in their estimation, being superior. The rise from the centre of the valley to the foot of the pass is very gradual, and its whole surface is covered with small varieties of artemisia, neither grass nor water being found near the road. The valley southward trends considerably to the east, and is uninterrupted as far as our vision could reach, although a low mountain extends into it for a considerable distance from the west, but eventually terminates in the plain. A small growth of cedar is scattered uniformly over the mountain in the vicinity of the pass, in which we encamped at a small spring of very bitter water, after a march of 15.18 miles, grass being abundant on the mountain sides. We met three Goshoot Indians during the morning, who accompanied us to camp. They were armed with flint-lock rifles and powerful elastic bows, made from the horns of the mountain sheep. Our most intelligent guide, Shippah, pointed out to me a small variety of ground-rat or gopher, and a black beetle-like cricket, which furnish a very large proportion of the food of his people. The grass also, on the seed of which they feed, he thinks of interest, and points out every tuft which we pass.

May 11.—The ascent became more steep as we approached the summit of the pass; the ravine narrow, and covered with a thick growth of stunted cedar, through which we were obliged to cut a road; and the descent still more abrupt and narrow, forced us to cut a road along its sides for a hundred yards—a considerable labor, as the ground was hard and rocky. Fortunately, just below the summit, we came to a small rivulet of running water, which leaks from the indurated shale and dark-blue limestone, overlaid by igneous rocks, of which the mountain is composed, and is much purer than that at our morning camp, which did not afford a supply at all adequate to our wants. The Indians say, however, that when the sun is hot, (mid-summer,) there is no water in this pass. It is not suitable for a railway. Like many of the mountain ranges in the Basin, this terminates in the plain to the south, and can be passed around by a long circuit. It was late when we extricated ourselves from this pass and encamped, having accomplished the short march of only 3.68 miles. The day throughout was dark and cloudy, and at night camp-fires were necessary to comfort, fuel being abundantly supplied by sage.

May 12.—We mounted our Indian guides on mules to-day, and furnished them with scarlet cloth for blankets, greatly to their delight—a merrier set of thieves seldom being seen. The morning was dark and cloudy, and a slight rain which fell during last night had moistened the light friable soil of the hills, making our early ride cool and pleasant. Leaving the base of the mountain, (2.43 miles from camp,) we crossed a field of heavy sand, and a few spaces of hard, barren white clay, succeeded by another field of sand, and then entered upon a soft, moist bed of clay or stiff mud, more or less miry at short intervals for nine miles, in which our riding-animals sank to the top of their hoofs, and occasionally to their fetlocks, and over which our loaded wagons dragged heavily. Eleven miles from the base of the mountain, however, brought us to an extensive field of small artemisia, extending far to the right and left, and sweeping quite up to the base of Granite mountain, which we were approaching at its northern termination. In this field the soil was light but dry, and the travelling fine; and we encamped at the point just spoken of, where we found a fine permanent spring of pure cold water issuing in abundance from the granite rocks in the bed of the ravine three-fourths of a mile above our path; but we were not so fortunate in regard to grass, only a few scattered bunches being found on this part of the mountain, which is a large isolated mass of granitic rocks, rising from the desert in which it stands, like an island from the ocean, to an elevation of 2,000 feet. Its general appearance is that of whitish naked rock, with a few small cedar-bushes in its narrow ravines. It disintegrates considerably, and forms the surrounding soil, which is filled with quartz and mica. Day's march, 19.76 miles; altitude of camp, (considerably above the plain) 4,666 feet above the sea.

May 13.—We resumed our journey at 5 o'clock a. m., directly across the desert, (which is that crossed by Stansbury, further to the north, where it is 70 miles wide, to which I have before referred,) south 45° west, (magnetic,) to the nearest point of the Goshoot mountains, which derive their name from the Indian band inhabiting them, although the name might better have been applied to the desert, which is characteristic of their utter wretchedness. Five miles from Granite mountain, we left the dry soil on which we terminated our march last evening, and passing over a narrow ridge of sand, entered upon a desert of stiff mud, as level as a sheet of water, which we found great difficulty in crossing with our wagons for 17.66 miles. For this entire distance there is not a sign of green vegetation, and only here and there a dry stalk of artemisia, where it has been transported by the wind. The lightest sheet of effloresced salt covered the moist earth at intervals, and the track of a single antelope or wolf could be seen crossing the desert for miles, by the line of dark mud thrown up by its feet, so level, white and soft was the plain; and the whole scene was as barren, desolate, and dreary as can be imagined. Fortunately the sun was partially obscured during most of the day; but even with the obscurity its reflection was very painful to the eyes, which were materially relieved, however, by one or two light passing showers, which dissolved the salt upon the plain, but greatly enhanced the fatigue and labor of crossing it. These storms, however, which had been hanging about the high peaks of the mountains all day, accompanied by thunder, increased in number and violence in the plain as we approached camp, and were accompanied by heavy squalls of wind from the southwest, and we were brought to a stand by a hail-storm, to which our animals turned their backs and obstinately refused to move until it had passed. Every object, when it was not storming, was distorted by mirage, rendering it impossible to form correct estimates of objects seen at a little distance—trees dwindling to mere twigs, and extensive lakes to glistening surfaces of mud, as they were approached. Very irregular detached mountain masses lay a few miles to the south, and a single one to the north, conforming in their course to no general theory of parallel lines of crests. The passage to the south of Pilot Peak, and another south of it, looked open and level, and it is by one of these that a railroad should pass west from this desert; the plain of which sweeps entirely around Goshoot mountains, preserving the same level, or nearly so, of our path and of the Great Salt Lake shore, where a road is already graded, or nearly so, but upon which it will be expensive, however, to construct a firm foundation for the road; for which extensive piling will be necessary in crossing all the miry beds. Approaching the Goshoot mountains, we came to a more firm and dry soil, covered with artemisia, for 2.34 miles to the foot of the outlying hills, where we found fine large springs of fresh water, sending out considerable streams to the plain. They were surrounded by large meadows of excellent grass. These springs are filled with small fish, and the Indians, therefore, give them the name of Pangwich or Fish springs. In anticipation of meeting their friends here, our guides dismounted before leaving the desert and prepared their toilet, for which they removed the dark surface-mud of the desert for two or three inches in depth, when they came to a white-clay mud stratum, with which they painted (bedaubed) themselves, in stripes, to hideous ugliness, remounted their mules, and appeared before their friends in holyday costume. We were soon visited by a number of the expected guests, extremely filthy and very naked, and emaciated by starvation during the long winter, during which their supply of rats and bugs fail, and they are reduced to the greatest extreme of want, if their appearance truly indicates it; and they are doubtless among the lowest of the human race in intelligence and humanity. We fed them and made them happy with small presents. There is a little scattered salt grass without the oasis spoken of; but it only extends a short distance, and is succeeded in the hills by artemisia, and in the desert by utter, desolate barrenness.

The teams arrived at camp between 6 o'clock and dark, very much exhausted by a march of 25.32 miles, in thirteen hours of incessant labor after a night of fasting. This desert, by the line by which we have crossed it, is forty miles wide, but less than thirty miles of it particularly deserves the description given of it where it is 70 miles in width further to the north, and the fine water in Granite mountain greatly relieves the hardship of crossing it by the southern line. Altitude of camp, 4,659 feet.

May 14.—It rained heavily during last night, and showers continued to fall in the mountains throughout the day, during which Captain Morris and Mr. Egloffstein made a reconnoissance of the mountains, and found them very practical for the passage of wagons. Camp was not moved.

May 15.—A heavy fall of rain at camp during last night, covered the mountains well down towards the desert with snow. Accompanied by Lieutenant Baker, Messrs. Egloffstein and Snyder, and a few men, I ascended to the summit of the mountain, and proceeded northeast along it, seeking for the best pass, and to determine with more certainty the practicability of turning its northern base. It is covered with fine grass and a low growth of cedar. The rocks were metamorphic, shale, and limestone. At 3 o'clock p. m. we descended to a fine creek six feet in width, descending from high snow-peaks to the south, and running along the western base of the first range of the Goshoot mountains, and breaking through it by a broad passage into the desert, where it disappears. The accompanying profile of the country explored crosses the desert from Granite mountain to the mouth of this creek, which it ascends to our evening camp. But it is still to the north of this line that the railroad should be carried by the line already indicated, and to which I should have immediately proceeded, had I not been led to suppose, by the Senate map of 1848, that the material from which it was constructed was in the possession of the government, and that the re-examination of the country was therefore entirely unnecessary. But, as I have already stated, our observation of that line was quite sufficient to determine its entire practicability and excellence as a railroad line. We now turned south, following Fish Creek valley, which is from 250 to 300 yards wide where we entered it, but soon opens to a much greater width, and sweeps off to the south and southwest. Ten miles brought us to camp, the main body of the party having crossed the mountains, under Captain Morris' direction, by a superior wagon-road measuring 18.63 miles. The valley is here several miles wide, and the stream lined with grass, which is not all, however, of a superior quality. Many of the small settlements of Utah are not so well supplied with the requisites for successful cultivation as those found on this stream, on which we found a band of twenty Shoshonee Indians encamped, besides women and children. They are mounted, and contrast strikingly with their Goshoot neighbors (Diggers) in the plump condition of their persons, although they complain of hunger; and in clothing, blankets and buffalo-robes being common among them. Our Indian guides left us here, as we were approaching the western line of their territory, and we endeavored, unsuccessfully, to obtain one from the Shoshonees to accompany us—their perfect knowledge of the country being of great service in designating the points at which water and grass can be found.

May 16.—Leaving camp, we took a nearly west course by the shortest route we could discover, leading to a favorable passage of the low mountains in that direction. The country was at first gently rolling, but soon became more broken and hilly, and covered with an unusual growth of cedar—artemisia covering the whole face of the country, and the soil light and dusty. The rocks of the lower hills were an indurated clay, and a sandstone, easily crumbled; but the higher hills were metamorphic, surmounted by granite. I rode to the summit of several high peaks to the north of our path, to obtain a better view of the country, and, if possible, to discover more favorable passes in this range, but without success. We therefore descended to the west to a valley but three or four miles in width—which extends northwest to the proposed railroad line, as we subsequently ascertained, and southeast to the head of Fish Creek valley, by which this mountain range can, therefore, be turned to the south, fifteen miles above our morning camp—and crossed to a pass marked by a high peak, at the southern base of which it ascends. The opening or gate to this pass, towards the valley, does not exceed 50 feet in width, the hills of metaphoric rocks being 200 feet high. The dry bed of the pass furnishes a fine road. It rained almost constantly on the mountains during the day, and a hail-storm and one or two showers swept over our path. We encamped a mile above the foot of the pass, and an equal distance below a small spring of fresh water, to which we did not proceed, as the fine grass of the mountain was saturated with rain, and we had provided ourselves with a supply in the morning, not knowing that it could be found at camp. Just before encamping, two or three Goshoots, who had declined to accompany us in the morning, came up with us, and others arrived during the night.

May 17.—We followed up the ravine, in which we had encamped, for three miles, to where a more broad and open passage to the north extends into the valley we crossed just below that camp, and, as we entered it, changed our course more to the south, and in three miles reached the divide, from which I rode two miles to the west to the summit of a high ridge, from which I obtained an extensive view of the valley to the west and of a large mountain-range beyond, extending considerably to the north and south, upon which there were still large fields of snow, and lying directly in the line I wished to explore. The intermediate valley was destitute of grass, and the distance too great, with an unfavorable light, to allow me to see any evidences of water on its western border. I returned, therefore, to the pass, and encamped a mile and a half to the west of its summit, at a fine spring, which sends out a fine stream watering a small field of grass, and again disappearing as suddenly as it rose. I made presents to the miserable, emaciated Indians who visited our last and present camps, and they were made happy not alone with cloths and knives, but pails-full of soup, on which I feed all who call on us. The morning was pleasant, turning cool towards noon, with light showers of rain in the evening. Near sundown, I again ascended the high western ridge to examine the country ahead with a more favorable light, by which I discovered a narrow lake, to which I gave the name of Goshoot, extending along the base of the succeeding mountain-range for several miles, and indications, by the vegetation, of fine springs at the foot of the same mountain.

May 18.—Last night was cold, freezing the surface of the ground to the depth of a quarter of an inch. Altitude, 6,550 feet. Leaving camp at sunrise, we continued down the dry bed of the creek for a short distance, but leaving it as we entered the valley, in which our course changed more to the north, for the purpose of passing around the north end of the succeeding mountain. The road was dry and hard, and the artemisia, which covered the whole face of the country, small. The water of Goshoot lake is shallow and bitter, and its banks miry. Crossing below its foot, which sometimes overflows, and sends out a small stream to the north, we encamped among numerous fine springs of fresh water, around which the fresh grass is just springing up, and the willows are just beginning to show their leaves. The day has been the finest we have enjoyed, and as yet (3 o'clock p. m.) we have seen no rain falling in the mountains. Day's march, 18.40 miles.

May 19.—We continued our northwest course this morning around the mountain, but, to avoid a long circuit in the plain, passed over the foot-hills of the range through a large growth of the cedar of the country. The range itself is terminated by a high round butte just north of the line of our trail. The valley of our last camp was seen to extend well to the north, and to connect to the east by other plains with the valley above Fish creek, just below our camp of the 16th, which would give an important line for a railroad from Great Salt lake, by a very uniform grade, but by a very circuitous route, were not the line by Pilot Peak, which was in sight, and with which this valley also connects, more direct, with equally favorable grades. To the north of the open passage, beyond the terminating butte above described, there is a remarkable peak, very broad at its base and sloping gradually up to its summit, upon which snow is still seen. This peak apparently terminates a short, isolated north and south range, of which it is the conspicuous feature, and a conspicuous land-mark. To the west of this peak we entered upon an extensive plain extending uninterruptedly so far to the north, that only the highest peaks of very distant mountains were visible above it. It also extends far to the south, but is much more broken by mountains. Turning a little south, we encamped, still on the mountain base, at fine springs, which send out small streams to the plain, watering small meadows of grass before they disappear in the absorbing soil. Day's march, 16.11 miles. As we approached camp we discovered near the springs the smoke of a Digger wick-ey-up, or lodge—that is, a smoke curling upwards from the sunny side of a cedar bush. Its inmates, or more properly occupants, were an old man and a young woman, the lowest beings in the scale of humanity I have any desire to see. They were greatly frightened when they discovered us, and the man escaped to the mountains; but the woman did not see us until too late to escape; and as she experienced no incivility, her companion afterwards returned, informing us, as he best could, that he fled taking us for Shoshonees. But he was still greatly in fear, and trembled from head to foot, and, with his companion, returned to the hills as often as curiosity or hunger induced them to come forth. They were filthy beyond description, and as ugly in features as in dirt. They had no shelter, no blankets—nothing but a deer-skin or two, a few ground-rats, a little grass-seed in grass baskets, food for themselves, and a variety of artemisia-seed, which the squaw ground between stones for food for two of the most emaciated and mean-looking dogs I ever saw. We could not discover the use they put these animals to in this condition, for they could barely stand, and the woman was constantly beating them with clubs to keep them from lapping the stones upon which their food was ground; but they were very anxious to obtain the fat dogs in our train for food. I made them presents of knives and calico, which astonished them not less than our arrival, by which they were made as happy as they were miserable an hour before. We fed them also, but they were, although half-starved, afraid to eat until they saw us partake of the same dish, so little are they accustomed to kindness from strangers. Their dialect was a gibberish which none of us could in the least understand, except when they introduced a word or two of some adjacent tribe. The language of the Diggers, in general, is a corruption and intermingling of a few words from those of each of the surrounding tribes, from whom, in part, they come themselves, it is said, being the Botany Bay fellows of all the Indian tribes in the great mountain world around them. They live a family or two in a mountain, and know nothing beyond the rat-holes of their own hills, being afraid even of their next range neighbors.

May 20.—I despatched my assistant, Mr. Egloffstein, with a party this morning to the northeast, and to the east of the high peaks described yesterday, to make topographical sketches of the route, and determine with accuracy the continuousness and practicability of the railroad line by Pilot Peak, to which we were about to return, while with the main party I crossed the plain west of our morning camp, and passing between low hills on the right, which are easily passed around by the north by the line for the railroad, and a considerable mountain to the left, entered the large valley, twenty miles in width in its broadest part, by sixty in length, lying at the eastern base of Humboldt mountains. It connects directly with that seen to extend so far to the north yesterday—indeed it is here the main part of that valley, which could be followed by a railroad, passing by the north end of Great Salt lake, and crossing the Humboldt mountains by this line. It is the most fertile valley known to exist in the centre of the Basin. Numerous streams descend into it from the elevated range of the Humboldt mountains, all the crest of which for a thousand feet below its summit is still buried in snow. To the largest of these streams I gave the name of Franklin river. It rises, by the union of several small streams, in the pass by which it is proposed to cross the mountain with the railroad, descends to the east to the base of the mountain, and thence flows south for many miles, forming the most considerable lake in the valley, of which there are several, but none of great extent. The lakes are surrounded, and all the streams are lined, with extensive meadows of coarse, tall, luxuriant grass; and the water, so far as we could ascertain, at least at this season of the year, is fresh, but near the lakes has a strong taste of decaying vegetation. The richest of the lands are, unfortunately, too low and wet for cultivation to their full extent; otherwise it would furnish lands for a respectable settlement.

We passed directly along the shore of one of the numerous ponds soon after entering the plain. It is shallow and its water colored by the clay of the soil, and not more than a mile in length. The day was bright and clear, and we rode for several miles in a due west course from this pond, although this course would bring us directly to the base of the mountains, where there is no possibility of crossing them; but the width of the plain is such—as we travel without any knowledge of the country in advance, not having been able to find a single person who had any knowledge of it by the line I wished to follow—that it is necessary to be sure of finding water and grass for our animals at night, which we could not fail to do at the foot of the snowy range we were approaching, although it increased the distance to travel beyond what it would otherwise have been. But in the middle of the plain we came upon Franklin river, the channel of which is thirty feet wide at present, and it has everywhere overflowed its banks; but in mid-summer it is doubtless a small stream. Turning north, towards the pass in the mountains, we encamped after a march of 21.52 miles, on the banks of the river, which are destitute of timber, but sage furnishes abundant fuel. I observed in the plain a curved line crossing it in a general northeast and southwest direction, and elevated perhaps 20 feet above its general level, evidently the shore of a lake which has existed here within a modern geological period.

May 21.—To avoid ponds and miry places, we were obliged to change our course more to the north, and in six miles crossed the wagon-road opened by Hudspeth and Hastings in 1846, in conducting a party of emigrants to California. It has been frequently followed since, but cattle are seldom in a suitable condition to cross the desert from Great Salt lake to Pilot Peak the same season that they leave Missouri. But it can be safely crossed by the line which we followed; but on arriving in this valley travellers should bear to the south, and intersect the line one day's journey to the north of the pass to which it leads in the Humboldt mountains. Packing parties can easily cross by the northern pass, however, to the valley of Humboldt river. Antelope, sage-cocks, and ducks were quite numerous in the plain and on the ponds.

Mr. Egloffstein and party rejoined us at noon. His observations and topographical sketches conclusively establish the practicability of the railroad line crossing from Cedar mountain to the south of Pilot Peak, and thence to our present camp—and its consequent superiority to all others in this vicinity. The general grades upon it will be readily determined by a reference to the level of our camps of the twelfth and thirteenth of May, and those of yesterday and to-day. The same references will also exhibit a singular feature in the formation of what is called the Great Basin, analogous to that observed in approaching the Rocky mountains from the east, where the gradual and uniformly increasing ascent from the Mississippi or Missouri rivers forms an immense trunk of table-land upon which these mountains are elevated. The altitudes referred to in the Desert are 4,666 and 4,659 feet, respectively, above the sea; and of our last and present camps, on quite as extensive a plain, north and south, as the former, 6,004 and 6,061 feet above the sea. And upon this elevated plateau, as in the case of the Rocky mountains, the most extensive and remarkable range of mountains we have seen in the Basin, the Humboldt, is elevated, its altitude being at least nine or ten thousand feet above the sea; and from the western base, as will be seen hereafter, a corresponding subsidence of plains takes place, extending quite to the foot of the Sierra Nevada, where we again return to nearly the altitude of the Great Salt lake. Latitude of camp, 40° 41′ 50″.

May 22.—To avoid the miry banks of numerous small creeks in the plain, we continued our course of yesterday until reaching the foot-hills of a mountain spur extending from the Humboldt mountains, from just north of the pass we were approaching, several miles into the plain, where it terminates, when we wound gently along its base, and crossed the main branch of Franklin river, (which descends from a high peak to the north of the pass,) a few yards above the plain. Though but twelve feet wide and three deep, we were obliged to bridge this stream on account of the miry character of the soil when moist, even on the mountain sides. From this creek, descending slightly, we passed over spurs of hills descending from the pass, and in 2.05 miles came upon a small rill descending from the lowest point in its summit, which was but 0.84 mile distant, 1.15 miles below which we encamped in a side ravine, finding it impracticable to descend with our wagons, on account of the miry character of the soil and of a rocky ravine commencing 1.33 miles below camp, to the valley of Humboldt river, which lies directly west of this pass. Numerous small creeks descending from various parts of the pass unite, forming a stream five feet in depth, at present, above the head of the ravine, through which it descends with a rapid current to the valley below. Its banks in the ravine are lined with willows and a small growth of cotton-wood, and large fallen rocks obstruct its easy passage, did not the soft soil forbid it. The narrow part of the ravine is three miles in length, and its rocky sides very abrupt; and some parts, particularly near its head, rise vertically to the height of 40 and 60 feet. On the north side, immediately above these rocky walls, the mountain spurs are rolling, or intersected by ravines, and rise rapidly to a much greater height than they attain directly above the summit of the pass. They are easily ridden over, however, in any direction near the stream. On the south side these hills are more abrupt, both towards the stream and the east, and are more rocky and broken, the narrow ravines partaking slightly of the character of cañones. Below this the ravine opens and is easily accessible on horseback, although the mountains are still high above it for three miles, whence they subside gradually into the Humboldt valley on the south side of the stream; but on the north side, are terminated quite abruptly by a remarkable round bald butte, standing directly in front of the pass in looking eastward from the Humboldt river. From the summit of this butte the country to the west is seen to great advantage. The Humboldt valley is broad and open for 30 miles between its main branches, which are seen descending from the north and south of this position; beyond which the mountain chains, which rapidly succeed each other, apparently rising from a common plain, overlap, and it is impossible to trace the course of the river without reference to maps. A few streams are seen descending towards it from the mountains in the immediate vicinity, but few of them, however, reach it, their waters being absorbed by the light soil of its valley. The whole landscape, except just above us, presents a sombre and even barren aspect, sage being the prevailing plant.

The main mountain depression of this pass exceeds two miles in width to the east, but at the head of the ravine, to the west, it does not exceed a half mile in its narrowest part, including the ravine which is only 100 or 150 feet wide. Snow covers the high peaks above it, and a few drifts extend in the ravines down to the level of its summit. The rocks are granite, quartz in masses, blue limestone, and slate, altered by igneous action. In approaching the pass from the east, advantage can be taken of the mountain spur which extends into the plain from its northern edge to the right of our path, to enter it and pass its summit by a longer and easier grade even than that given in the accompanying profile, which indicates the natural grade by which we ascended it; and in descending to the west, its width and the character of the mountain sides are such that some advantage can be taken of them to effect the descent by a line following the hills on the north side of the pass, but this advantage will be confined chiefly to that portion below the rocky ravine.

The ascending grades from our morning camp, as indicated by our barometers, are, for 7.65 miles, to the crossing of Franklin river, 58.10 feet per mile, and thence to the summit of the pass, 2.89 miles, 25.10 feet per mile, the altitude of the summit being 6,579 feet above the sea; and the descending grade to the west, for the first 0.80 of a mile, 78.30 to the mile; and thence to the base of the bald butte, 8.36 miles, 96.70 feet to the mile. Below this point we enter the valley of the Humboldt river between its north and south forks, their junction being, by the course of the creek descending from this pass and the north branch of the river, thirty-five miles distant, with an average descent of 28.50 feet per mile.[*]

The valley of the Humboldt river having been explored by Colonel Frémont, and so favorably represented for the line of a railroad, no further examination of it was deemed necessary; and being obliged to proceed sixty miles south to cross the Humboldt mountains with our wagons, I determined to proceed west from that pass across the Basin by a route not before explored, returning to the valley of the Humboldt near the point at which it is proposed for the railroad to leave it in its western course. The 23d of May having been spent in examining the pass described, we resumed our journey on the following morning.

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[*] The Humboldt river "rises in two streams in mountains west of the Great Salt lake, which unite, after some fifty miles, and bears westwardly along the northern side of the basin. * * * The mountains in which it rises are round and handsome in their outline, capped with snow the greater part of the year, well clothed with grass and wood, and abundant in water. The stream is a narrow line, without affluents, losing by absorption and evaporation as it goes, and terminating in a marshy lake, with low shores, fringed with bulrushes, and whitened with saline incrustations. It has a moderate current, is from two to six feet deep in the dry season, and probably not fordable anywhere below the junction of the forks during the time of melting snows, when both lake and river are considerably enlarged. The country through which it passes (except its immediate valley) is a dry sandy plain, without grass, wood, or arable soil; from about 4,700 feet (at the forks) to 4,200 feet (at the lake) above the level of the sea, winding among broken ranges of mountains, and varying from a few miles to twenty in width. Its own immediate valley is a rich alluvion, beautifully covered with blue-grass, herd-grass, clover, and other nutritious grasses, and its course is marked through the plain by a line of willow, * * * serving for fuel.

"This river possesses qualities which, in the progress of events, may give it both value and fame. It lies on the line of travel to California and Oregon, and is the best route now known through the Great Basin, and the one travelled by emigrants. Its direction, mostly east and west, is the right course for that travel. It furnishes a level, unobstructed way for nearly three hundred miles, and a continuous supply of the indispensable articles of wood, water, and grass."—*Geographical Memoir addressed to the Senate of the United States in* 1848, *by Colonel Frémont—June*, 1848.

CHAPTER III.

From the valley of Franklin river, east base of the Humboldt mountains, to the crossing of the Humboldt river—May 24 *to June* 9, 1854.

Journey along the eastern base of the Humboldt mountains.—Forty hot springs.—Mountain chiefly granite.—Eclipse of the sun.—Lakes.—Shore-lines.—Digger Indians.—Fevers.—Numerous Springs.—Outlet of subterranean river.—Passage of the Humboldt mountains to the southern branch of the Humboldt river.—Interior or secondary basin. Digger methods of catching gophers and marmots.—Indian singing, lodges, and wardrobes.—Quartz mountain.—Agate Pass.—Rheumatic fevers.—Snow-storm.—Difficult mountain passage.—Lake and miry plain.—Edible roots.—Return to proposed railroad line.—Description of the valley of the Humboldt.—Character of the vegetation of a large portion of the country between the Rocky mountains and the Sierra Nevada.—Humboldt river.—Bad character of its water and grass.—Cause of the loss of stock; how avoided.

May 24.—We travelled south along the eastern base of the Humboldt mountains, crossing numerous small creeks, and at our camp a mountain torrent, which we were obliged to bridge, although it did not exceed twelve feet in width by two in depth, but it poured by with great fury; yet we were but a few hundred feet above the plain, which we were obliged to avoid on account of the miry banks of its numerous creeks. The base of the mountain is finely covered with grass, but we occasionally passed fields of sage and thorny bushes, the latter covered with myriads of nesting caterpillars. Before leaving camp this morning, a few miserable Indians came in, but they were very wild and timid; and we met a naked, stalwart fellow during the day, whom I adorned with rings.

In the plain at the foot of the hills near our camp this evening there are some forty hot springs. Their orifices are in granite—the water boiling up as from a well into funnel-shaped basins, and a small pond is formed by their united waters, with vertical granite walls even with the surface of the plain. There is a slight odor of sulphuretted hydrogen about them, but the water, when cooled, tastes pure and fresh, and is limpid. They are more or less intermittent in their action, and the temperatures of the different springs vary from 120° to 170°, and the total amount of water which they discharge is small. The mountain above us and along our path to-day is almost entirely granitic—sometimes very fine, at others feldspathic and crumbling, or micaceous and disintegrating. The morning was very beautiful and pleasantly cool, and mid-day warm; but we were thoroughly drenched by rain before encamping. Day's march, 19.17 miles.

May 25.—It commenced raining soon after daylight this morning, and continued until night, making the soil very soft for travelling, and swelling every rivulet to a mountain torrent; so that, although we started at the usual hour, and did not encamp until late, we made but 7.99 miles; and, although we built several bridges in this short distance, several of the gentlemen were thrown into the swollen streams, their riding-animals being thrown down by the force of the water; but this bathing was of little consequence, as we were all thoroughly drenched from early morning until sundown. We remained in camp on the 26th, for the purpose of observing the eclipse of the sun, for longitude, for which we were very anxious, all our previous efforts having proved so abortive. But the morning was unfortunately very cloudy, and we failed in seeing its commencement, and were no more fortunate at its termination, the sun only occasionally breaking through the clouds during the day, and being too much clouded for the exact observation of its termination. The day was considerably darkened and chilled by the obscuration. Our camp is magnetic west from the point where we entered this valley, near a small lake, six days since.

May 27.—We continued along the base of the mountains, crossing several small streams, and emcamping, after a march of 13.93 miles, at the mouth of a narrow ravine by which an Indian trail passes over the mountains. I ascended it quite to the summit, overlooking again the valley of the Humboldt river, towards which several small streams were seen flowing from mountains west of that on which I stood. On the peaks of two or three of these mountains, only, could I see snow, and on these in but small quantities. The country, except by the course of the Humboldt river, looked very broken and difficult to cross. This pass is only fit for a mule-path, as the ascent by the most advantageous line is 1,200 feet in the first three miles.

The lake spoken of before, several miles in extent at high water, we passed to the east to-day. It is lined with grassy marshes on the west, and apparently by sage-plains on the east, and is very shallow, the shoals appearing here and there above its surface. From my position on the summit of the mountain I could see a high shore-line across its southern end, dry and easily crossed; but it is immediately succeeded to the south by ponds and marshes of considerable extent. Several Indians—Diggers—whom we met, collected a score of their friends, and accompanied us to camp. They are better clothed (in skins) and less afraid of us than those we have before seen. They are accompanied by but one squaw, who has a child a year old, of which she is very fond, and its father plays with it in its new finery—a sight I have never before seen among wild Indians. An equally strange sight was that of the only horse possessed by the party, packed with their effects, surmounted by the child, while the father walked and the mother carried no burden. Several of our men are quite ill with fevers.

May 28.—I engaged an Indian to accompany me to-day in order to gain from him such information of the country as he possessed; but he soon deserted and returned, with two companions who accompanied him, to his people. From the base of the Humboldt mountains a very large number of fine springs burst out and flow into the ponds and marshes to the left of our trail: all the water indeed—and it is a large amount—with the exception of one or two small creeks of this portion of these mountains, bursts in springs from their base. In a single mile I counted fifteen, any one of which would have been a remarkable spring in another locality; but one of them was, even here, remarkable, both in volume and beauty. It bursts from the base of a vertical rock of blue limestone, nearly 50 feet in height, in the face of the mountain, in a single stream like the escape of a subterranean river, and pours down in a foaming white sheet over detached rocks for 40 or 50 yards; and thence continues on in a rapid limpid stream, 15 feet in width, and one in depth. The streams from several of the other springs were nearly as large, but none compared with this in beauty. The numerous ponds and marshes formed by them seem to have no outlets; at least we could discover no stream flowing from this valley, which receives a very large amount of water, all of which must be carried away by evaporation.

Twenty miles from our morning camp we turned west, and began the ascent of a pass which an Indian described to us by placing his open hands side by side, and gently separating and elevating them, indicating a broad open depression in the hill or ridge rising to high summits on either side. Its width is six or eight miles, and it is a very superior natural wagon-road, for which it has been used considerably in the early days of emigration to California, the Hastings road passing over it. It is 5.18 miles from the eastern plain to its summit, which is covered by a fine growth of cedar, and an equally fine growth of grass. The descent is also broad, and ten miles in length to the western base of Humboldt mountains to where the southern branch of Humboldt river flows past, which is followed by Hastings' road to the junction of the north fork. We encamped, after a march of 35.11 miles, at a late hour, our dinner not being served until 10 o'clock at night. The valley of this creek is uninterrupted to the eye from Humboldt river far to the south.

May 29.—We travelled four miles over a field of rank sage, and entered a dry, grassy ravine from fifty to one hundred and fifty yards wide, leading to the succeeding summit, 6.83 miles from our morning camp, whence we descended by the same cañon ravine to the succeeding plain, some fifteen miles in extent, enclosed by mountains to the east, south, and west, and by considerable hills to the north, and is therefore a "basin," in the centre of which, at times, if not permanently, there is a respectable-sized lake. We crossed the northern end of this plain, where it is covered with rank sage from three to five feet high, and proportionably large, our course being directed to the most favorable western depression in the succeeding range, which we ascended slightly, and encamped, after a march of but 16.02 miles, in fine fields of grass upon the banks of a small rivulet.

Last night was quite cold, snow falling on the mountains, and a few flakes in the valleys, and ice forming on the water; and at sunrise, the thermometer stood at 26°. The party were wrapped in their overcoats during the whole day, and fires are pleasant this evening. But, notwithstanding this indication of the climate, the blades of grass are eighteen inches long.

May 30.—We passed the low summit at the depression near which we had encamped, finding a small creek flowing west, which we followed towards the next valley until the hills confined it within too narrow limits to admit of our passing in its ravine; at the same time, the mountain rose high and abrupt to the west, covered with a thick growth of cedar, interspersed with a few small pines, through which we were obliged to cut a road to its summit. The western descent, for a thousand feet, was very steep, and intersected by vertical ledges of metamorphic rocks, broken and fallen at intervals, enabling us to descend with our wagons, when we again returned to the creek, on which we encamped at the termination of the mountains, surrounded by an immense growth of sage interspersed with grass. Day's march, 10.44 miles. The night was cold, ice forming in our tents.

May 31.—We entered a large valley, extending north to Humboldt river and far to the south, and covered with sage, except in a few spots white with incrustations of salt. The chain of mountains to the west is not so elevated as those passed heretofore; but a high, snowy peak, and the sharp crest of a considerable range, are seen far to the south, dividing the valley. Several small creeks were crossed flowing into one main one, which descends towards the valley of the Humboldt. Reaching the western mountains, we came to a small stream of excellent water descending from the pass we were approaching, and ascended two miles, when we encamped, having travelled 21.94 miles. We saw but little grass during the day, but it is abundant among the sage on the hills about our camp.

A single Indian visited us this morning, and two or three were seen during the day industriously employed in catching small ground-squirrels or gophers, upon which they subsist to so large an extent. They are very numerous, and in fine condition at this season of the year. The Indians shoot them with blunt arrows, catch them in ingeniously contrived "figure-four traps" set at the mouth of their burrows, and dig them out of the earth with their hands; and it is not unusual to see them carrying forty or fifty, the reward of a single day's hunt. Forty Indians (Diggers) were gathered at our camp at sundown this evening—all males, and generally unarmed. I ordered camp-kettles of soup for their supper, and made them presents of a few knives and other articles, which put them in such good humor with themselves and our party that they spent the entire night at the fire assigned them, under the eye of the guard, singing and rejoicing, and annoying us by their grunts and nasal sounds, of which all Indian singing is made up—sounds anything but agreeable to civilized ears. At daylight their number was increased to fifty; and as I arose, the arrival of a chief was announced by the oldest acquaintance we had in the band, and he was soon paraded before me to receive the lion's share of the bounty in which he had not participated the previous evening. I covered him and his son, a small boy, who stood by his father's side, in scarlet, greatly to their delight. The claims of those who had arrived during the night were next urged; but I had no time to attend to their wants, and informed them that they would receive no more—"Kay-wit," in their miserable language—when their importunities ceased. Their wigwams—wick-ey-ups, as they call them—are superior to those we have recently seen. They are bee-hive shaped, four feet high, and partially covered with grass. The opening of every one that I have seen in the Basin is towards the northeast, an indication of the prevalent direction of the storms.

June 1.—Two miles and a half, by an easy ascent for wagons, brought us to the proper summit of this pass, to conduct us to which, one of the Indians constituted himself guide, running before my horse and pointing out every stone and bush that he was to avoid, while several others were occupied in catching rats along our path; but the main body preceded us a short distance, and appeared in great haste, which excited my curiosity, and I rode forward to discover the cause of it, from which it appeared that, as a matter of policy, or a precaution to prevent being despoiled by robbery of their wardrobes, in visiting us the previous evening, they had, each for himself, made a cache of his effects under separate bushes, and for the same reasons they were now hastening to remove them from where we were about to pass. It was indeed a novel and ludicrous sight of wretchedness to see them approach their bush and attempt, slily, (for they still tried to conceal from me what they were about,) to repossess themselves of their treasures, one bringing out a piece of an old buckskin, a couple of feet square, smoked, greasy, and torn; another a half dozen rabbit-skins in an equally filthy condition, sewed together, which he would swing over his shoulders by a string—his only blanket or clothing; while a third brought out a blue string, which he girded about him and walked away in full dress—one of the lords of the soil. With these simple wardrobes they were all soon reclothed, and we arrived at the same time at their lodges, deserted by their women, and upon the top of the pass—that is, to where a respectable stream rose and flowed to the west. But owing to the formation peculiar to so many of the mountains in the Basin, and upon our continent generally, we had but just commenced the ascent necessary to its passage in its natural state. For, though the streams continue to flow to the succeeding valleys, which are open and easily descended, frequently for miles, the mountains still continue to rise to the west, and the valleys are again closed up by their close proximity, and the streams break through the last and highest ridges in deep, narrow, rocky ravines and cañones, which terminate abruptly to the west. This was the case in this instance, and we were obliged to ascend a thousand feet higher before commencing the descent, and were then obliged to encamp, and put all our well men—for we had several sick with rheumatic fevers—to work to level down a roadway on the side of the ravine we were descending. From the top of the valley the view was extensive. To the west a small valley, containing small ponds of water, sweeps off to Humboldt river, and is succeeded by numerous mountain ranges of limited extent, and by two large ranges upon which there are still large banks of snow. This mountain is characterized by large masses of beautifully colored quartz, and we therefore gave it the name of Quartz mountain, although it is chiefly composed of dark metamorphic rocks. To the pass, Dr. Shiel, geologist, gave the name of Agate, that stone being profusely scattered about in large blocks. Day's march, 6.83 miles.

June 2.—Owing to sickness among the men, with new cases of rheumatic fever daily occurring, it was necessary to remain in camp to-day, during a heavy fall of snow, from 6 a. m. until noon, when we proceeded to the foot of the pass, 2.65 miles, and encamped; but during this short march we were thoroughly wet by a shower of rain, and a second swept over us after we had encamped. This pass, though easily ridden up, would be in some parts very difficult to ascend with wagons. The valley in which we encamped does not exceed nine miles in width where we entered it, but a little to the north the mountains trend to the east and west, and it becomes broader, but again becomes narrow before joining the main Humboldt valley. Several small streams descend into it, forming the grassy ponds already described. Two or three varieties of artemisia constitute its chief vegetation. Its soil is very light and friable; the track of a single Indian crossing it being plain and distinct.

June 3.—A cool and pleasant morning. Crossing the valley of our morning camp, we ascended a range of low hills of altered rocks, which could be easily passed around to the south, and then crossed another small valley, from which a creek flows into the one first crossed, and passed over a second range of hills, as easily turned, and encamped on a creek which descends to a small pond two miles distant. Scattered over the hills there are a few bunches of wheatgrass, and on the stream a narrow margin of the broad-bladed grass of the country, and sage supplies us with fuel. We see daily a few varieties of wild flowers scattered along our path. The rocks in the vicinity of our present camp are a coarse, crumbling granite.

June 4.—It was again impossible to cross the mountain, (at the foot of which we had encamped,) by the lowest depression in it, on account of a narrow ravine with steep sides and rocky projections at short intervals, and large stones in the bed of the creek which trickles down it. We therefore turned north, following for some distance the ravine of a large stream coming from high peaks in that direction; but it became narrow and miry, obliging us to leave it and wind round from hill to hill until we reached the summit of the mountain, which was itself very springy and miry, and we passed a small pond on its narrow summit. There are no trees upon it, but a few scattered cedar-bushes and a luxuriant growth of bunch-grass. From the high peaks near the pass the valley of the Humboldt was seen, 25 or 30 miles distant, to which the valley to the west extends. The descent was more steep, springy, and miry, than the ascent, and filled with out-cropping strata of altered rocks, in the passage of which two or three of our wagons were broken. By the wagon path it was 8.44 miles from our morning camp to the top of this pass, with a difference of level of 2,019 feet, the altitude of the summit being 7,315 feet. We encamped near the succeeding valley, 3.04 miles from the summit, and 1,667 feet below it.

June 5.—In the valley which we crossed this morning there were numerous ranges of hills, and twelve miles to the west a low, bluff mountain, around the north end of which we passed, coming upon a small lake of brackish water surrounded by miry, desert plains, in all respects like those immediately west of Great Salt lake. Crossing the foot of these miry plains, from which the sun was reflected with great power, we encamped at the mouth of a ravine in the succeeding mountain, from which a fine stream of cold water descends. In the first valley crossed, no vegetation was seen except artemisia, and the soil was alternately light and dusty, and smooth hard clay. The mountain at camp is formed of altered rocks and of a hard, blue limestone. Day's march, 30.10 miles.

June 6.—We passed around the north end of the mountain of our last camp, through a broad depression two or three miles in width, in which there were fine springs of water and a respectable growth of cedar. The ascent of our road was inconsiderable. On the north of the passage stands a small mountain, which sends out a high spur to the southwest, which I ascended, and from which the view was extensive. Mountains succeed mountains rapidly, and the valleys become small and irregular. The one which we were entering sends out a small stream to Humboldt valley, and is bounded by a high, snowy range to the northwest, which gradually subsides towards the south, where it trends to the eastward and unites with the one we were passing—the rocky strata of which dip from each side towards its centre. We encamped in fine fields of grass, with sage for fuel, at the foot of the mountain which trends eastward. Two or three Indians were seen during the day, which was fine with a pleasant breeze, with thunder-showers in the mountains. Day's march, 14.12 miles.

June 7.—Guided by the Digger Indians, who call themselves Pah-Utahs, however, we passed easily over the mountain at our last camp through luxuriant fields of grass and sage. The ascent from camp was narrow only for a hundred yards, the hills sloping easily upwards; and in the mountain there was a broad depression, followed by a descending plain 75 yards in width, at the foot of which there are fine springs of water which we passed as we entered the succeeding valley, which is ten miles broad, and extends to the north to Humboldt river, but is shut in to the south by mountains. The soil of the valley is friable and dry, supporting only a small variety of artemisia. Leaving the valley, we encamped well up a ravine in the succeeding mountain. This pass is grassy, well watered, and easy to ascend to the summit. There are a few small cedar-bushes only in the mountain, but sage covers all the hills. Indians were digging roots about us, which were of the size of ground-nuts, with a pleasant taste. A few presents made them happy. Distance, 20.57 miles.

June 8.—Leaving camp at 6 o'clock this morning, we passed the summit of the mountain, and descended the opposite slope on the banks of a fine creek which flows into a desert plain in the southern part of the succeeding valley. This valley is ten miles wide where we entered it, and extends to the south and west entirely around the next western mountain-range, which is elevated and quite snowy towards the north, where it is terminated by a high peak marking the southern border of Humboldt valley. The soil is light and covered with artemisia. In entering it we changed our course considerably northward, and passed over a low spur of the western mountain, where it descends to the valley of the Humboldt river. In entering this plain, we returned to the proposed line for the railroad. The valley of the Humboldt, as seen here, is from eighteen to twenty miles wide, its soil very light and friable, with extensive districts of sand, more or less covered with the several varieties of artemisia, which occupy so large a proportion—at least nine-tenths of the plains—of our territory between the Rocky and Sierra Nevada mountains, and characterize its vegetation. To the south of the river, and for a short distance to the north, the mountains are generally similar to those we have so recently crossed, which run out as they approach the valley. Many of them do not exceed twenty or thirty miles in length, and are easily passed around upon the general level of the plain. They are generally very narrow, and, in their elevation, seem nowhere to have disturbed the strata of the plain above which they rise; or, more properly, the earth of the plains—for they are without rocks—seems to have been deposited since their elevation.

Four miles from the mountain we reached the river, and encamped. The river-bottom is a mile wide, the stream, just level with its banks, winding, from side to side, to where the second banks or bluffs, twenty feet high, rise to the level of the main plain of the valley. Willows line the stream in many parts, but trees are nowhere seen on the Humboldt. Its water, even at this season, is not superior, and becomes less so as you descend it, and as it subsides after the spring rise. It is now 40 yards wide when all collected in one channel, and eight feet deep, flowing with a moderate current. There are no fish in this part of it larger than minnows. The width and character of the valley as here given extends as far as we can see, many miles above and below, and is precisely like the portion we entered at the foot of the Humboldt mountains, and such is its general character. It is infested with mosquitoes and sand-flies. The day has been very pleasant. March, 30.26 miles. The altitude of camp above the sea, 4,141 feet.

June 9.—We moved camp but 6.80 miles down the river to a point selected for crossing it, where it has no bottom-land upon it. These low lands being very much overflowed at this season, and miry, are entirely impassable for horses or cattle; and many arriving here in a weak condition, are annually lost by emigrants from becoming mired. But one of the chief causes of the loss of cattle by emigrants upon this stream, is allowing them to eat the grass in the river-bottom, which is extremely unwholesome. The more experienced stock-drovers to California, send their cattle back from the river to feed on the nutritious grass of the hills; but, as these are frequently distant from the road and from water, it is only by experience that men learn its importance.

CHAPTER IV.

From the crossing of Humboldt river, via the Madelin Pass, to the junction of Fall river with the Sacramento, and back to the shore of Honey lake, eastern base of the Sierra Nevada—June 10 *to July* 4, 1854.

Crossing Humboldt river.—Droves of cattle and sheep.—Lassen's meadows, and termination of the western course of the Humboldt river.—Country and passages to the west.—Willows and water.—Mud lakes.—Noble's road.—Railroad grades.—Mud lakes, or plains and deserts; their passage.—Frémont's trail of 1844.—Similarity in geological character of some of the mountain spurs and plains.—Examination of the Sierra Nevada; their broad, massive, and terrace character.—Marshes, ponds, and stony surface.—Indians.—Madelin Pass examined.—View of Mount Shasta.—Grades and altitude of pass —Country southeast of the broad plains of Madelin Pass.—Light, miry, and stony soil.—Indians.—Basin character of the broad plains of the summit of the Sierra.—Game.—Error in location of Feather river on the best authenticated maps.—Forests.—Descent to Round valley; waters of the Sacramento.—Practicability of this descent for a railway —Indians, (Pah Utahs?).—Grave.—Emigrant road (Lassen's) and Oregon road.—Source of the Sacramento; its first cañon.—Grades.—Pitt river; Pah Utah or Digger Indian women digging roots.—Making arrow-heads.—Indian pantomime —Impracticability of descending the Sacramento with wagons; its examination to the mouth of Fall river.—Impassable volcanic rocky fields.—Character of the river banks.—Timber.—Grades.—Reference to itinerary, from July 15 to 21, for a description of the Sacramento below Fall river.—Recrossing the Sierra Nevada.—View of peaks of the coast range.—Graves of emigrants.—Pine creek.—Noble's Pass road —Summit creek.—Susan river.—Eagle lake.—Roop's farm in Honey Lake valley.

June 10.—We crossed the river by a small wagon-boat brought with us for the purpose, and descended the stream 3.51 miles to camp. Fine droves of cattle, which had been wintered near Great Salt lake, passed to-day on their way to California, and one or two large flocks of sheep are but a few miles behind them. Latitude of camp, 40° 42′ 03″.

June 11.—Our last camp was in a large bottom of coarse grass—the last found on this river above its sink—known to emigrants as Lassen's Meadows, in which the river terminates its general western course, and turns south for 40 miles, where it reaches the marshy lake in which it disappears. Immediately north of the meadows there is a detached mountain range, a few miles in length, behind which there is said to be a favorable passage to the west, leaving the river, of course, a few miles above where we returned to it, but in sight. The same passage is entered by the west end of the mountain by a northwest course from yesterday's camp. It is by this line that Noble's route to California, followed to some extent by emigrants, leads to Mud lake, and it is believed to be the most favorable route for reaching that lake from the river; but its eastern portion did not appear so favorable to us as one further to the south, which we followed after ascending the highest mountain in the vicinity, and examining the connections of the respective passes westward. By the one we followed we descended the course of the river for 9.64 miles, and then bore off to the southwest over the foot-hills of a mountain just west of this part of the river. Still further to the south, the country becomes more open, and no obstacle could be seen to approaching Pyramid lake on the general level of the Basin; but this would have taken us too far to the south for our present purposes, if it could be avoided, and we therefore followed what appeared the best route. The soil of the valley and foot-hills was of ash-heap friability; but as we ascended the broad, open mountain depression it became firm, being formed from the disintegrations of granite rocks. The ascending grades to the summit of this pass are, for the first 9.64 miles from our morning camp, 16.20 feet per mile; but, from the formation of the hills, the distance can be increased to diminish the succeeding grades, which average 23.20 feet per mile for 7.86 miles; 64.30 feet per mile for 6.93 miles; and 97 feet per mile thence to the summit, 5.50 miles distant. The width of this depression, in its narrowest part, exceeds one and a half miles.

We were obliged to leave it, however, to find water and grass, encamping on a granite peak to the south, and several hundred feet above it, where the grass was abundant, and a small spring furnished a sufficient supply of water.

June 12.—The pass to the west is equally as broad and open as to the east, with a descending grade of 87.20 feet per mile for 10.55 miles, and of 30.50 feet to the mile for the next 4.68 miles; and thence to the succeeding valley, 1.85 miles, 73.50 feet per mile. This valley extends far to the south, and doubtless to the east to Humboldt river, passing to the south of this mountain, and west to Pyramid lake. It extends, however, only 12 or 15 miles to the west, opposite the point where we entered it. The western portion of it is entirely barren, and in the spring is doubtless covered with water. To the north the plain of the valley ascends considerably, and becomes narrow, not exceeding two miles in the narrowest portion. It was late in the afternoon when we entered it, and we could nowhere see any indications of water. We therefore turned northward, and were gradually approaching the west side of the valley when we discovered a bunch of willow-bushes on its east side—an unfailing sign of water in this country—where we found a small spring, and scattered grass in the plain two miles below. The plain was level for 2.55 miles by the path we followed, and ascended 21 feet per mile for 8 miles to where we left it to encamp. The mountains about us are not elevated enough to retain snow at this season, and are very dry and destitute of timber. The rocks in the higher parts are coarse granite, but lower down are shale, and hard dark-red trachytic strata. The day has been cool, with a high southwest wind and slight showers. Day's march, 28.75 miles.

June 13.—From our morning camp our path lay west to a depression, two or three miles wide, in the succeeding ridge, from which we descended northward over the base of hills extending towards the western valley, directing our course to an open passage in the next western range, at the foot of Mud lake, or rather through which that lake extends, to the foot of the Sierra Nevada. Finding, however, that we should not be able to reach it before night, it was necessary to leave the barren sage plain, and ascend the mountain to the west, to find a camp. But although the grass was abundant, we were unable to find water. Several slight showers during the day, however, prevented great thirst, and one at evening moistened the grass for our animals. The most eastern of the miry plains, called Mud lakes, lies 11.75 miles directly north of the camp. Its southern border is followed by Noble's road, which follows one of the most favorable lines by which the passes we are approaching in the Sierra Nevada can be reached from the east, and in the event of future surveys being conducted in this part of the basin, it is worthy of examination. In crossing the valley which extends to this lake, in approaching camp, we passed over a high mass of rolling hills, which should have been avoided by extending our course to the west in the earlier part of the day; or in leaving the preceding pass, we should have maintained our level by travelling on the east side of the valley, and thus have avoided the descent and rise indicated by the profile, for though the grades are not heavy, they are to some extent unnecessary. As before stated, the depression crossed in the ridge this morning is broad, and can be ascended by a line at least twice as long as the direct one followed by us, which would make it entirely a practicable grade in its unimproved condition for a railroad. From the centre of the valley east of that pass, we ascended 69.80 feet to the mile; and thence to the summit, 1.37 miles, the ascent was 207 feet to the mile. For 2.55 miles west of the summit, the descent was 40.30 feet per mile; and the average ascent for the next 7.04 miles, 44.40 feet per mile; while the change of level indicated by the barometers in the succeeding 2.54 miles was but 43 feet. Day's march, 24.12 miles.

June 14.—We crossed the mountain on which we had encamped, immediately to the west, and descended to a branch of Mud lake. The soil of these plains is very light, and our animals sink quite as deep in many of the parts, dry upon the surface, as in the wet and miry portions. The name of *lake* is liable to mislead you in regard to the character of these mud-flats. It is true, there is a small sheet of water upon the surface of a small portion of the most eastern of them, and upon the most southwestern also; but their general character is precisely that of the Desert west of Great Salt lake—a plain of mud, more or less miry at intervals, destitute of vegetation, with a surface, especially when recently moistened by rain, presenting at a little distance a perfect resemblance to a sheet of water. It is here and there incrusted with salt, but not to the extent of the desert referred to. The first branch of these plains which we crossed was 6.90 miles in width. At this point we crossed Frémont's trail of 1844, leading from the Boiling springs to Pyramid lake. We then travelled along the north end of one of the ranges or spurs of mountains terminating in these plains. I experienced great difficulty in ascending it a few hundred feet on horseback, its composition being in many parts precisely that of the plain, into which, of course, it is washed by every shower. Granite is, however, found in the same mountain, and vegetation in some parts, but there is none upon the friable surface. It was late in the day when we arrived on the eastern border of the second branch of the plain, and it was very doubtful whether we could cross it. There was no alternative but to try it, however, and sleep in the mud if we failed; for, although on a lake, we were without water, nor could any sign of it be discovered, nor of grass. Taking a few men with me, therefore, I at once set off, leaving the party to follow with Captain Morris, if I should not turn back in a short time. But although the road was heavy, we experienced no difficulty in crossing this branch of the lake for ten miles to the foot of the Sierra Nevada. The sun was bright, although the day was very smoky, and the reflection severe upon our faces and eyes. When in the centre of the plain, we were gratified by the sight of bushes and of green vegetation in the mountain we were approaching, indicating the position of springs and of small streams; but the streams did not reach the lake, and we experienced much difficulty in ascending to them, as they were upon a terrace, in front of which the ascent was very steep, and so covered with blocks of trachytic rocks, that it was only after great exertion that our animals were driven over them to water and grass. We were here upon the Noble road, which follows the north shore of the lake by the Boiling springs. In descending to Mud lake north, from the valley east of our morning camp, the grade is 76.60 feet per mile for 11.75 miles, and thence to our present camp, or indeed to any point upon the borders of these plains, the change of level is merely nominal. Day's march, 25.27 miles; altitude above the sea, 4,118 feet.

June 15.—I remained in camp to-day to refresh our animals and give the party rest, its severe labors from sunrise until sunset every day, and frequently until midnight, with the men on guard every third or fourth night, requiring relaxation.

June 16.—In order to discover a practicable railroad pass, if possible, in the Sierra Nevada—this portion of which had never been explored—I determined to examine every opening and depression which could be seen to the east, commencing with the northern, and proceeding towards the south—determining not only the merits of each, but establishing their comparative value. The first of these openings we reached by turning gradually westward three miles south of our last camp, and crossing a branch of Mud Lake valley, 8.85 miles to its foot. I there entered a level, narrow ravine, varying from 50 to 200 yards in width, and more or less winding for six miles. Its walls are precipitous, and at a few points vertical. Large rocks lay scattered about its bed, preventing its use by wagons, and ours were sent further to the north over the hills, but descended to the creek to encamp, having marched but 15.20 miles; our ascent by the course of the stream being but about 200 feet above Mud lake. The mountains here are thoroughly trachytic, and many of the rocks partake of a volcanic character—black, red, and white in color, and porous in their formation.

June 17.—Fallen rocks, thick willows, and a miry soil prevented us from following the ravine, the sides of which were also difficult to follow, being constantly broken by side ravines, as deep and nearly as large as the main branch—the rocky sides of which vary from 50 to 200 feet in height, and are too steep to be ascended on horseback. But as its course was sufficiently direct and its ascent gradual, it was necessary to examine it still further; but it began to rain at an early hour of the day, and we encamped, having advanced but 3.78 miles.

June 18.—From our last camp we left the ravine with the train, and, by a rapid ascent and winding course on its southern side, in two miles reached one of the broad terraces which characterize the formation of this portion of the Sierra Nevada. Crossing this terrace for 1.50 miles, we again rose to a terrace elevated considerably above the first, and then continued to the summit of this part of the mountain by ascending to successive terraces, approached by steep ascents of but a few yards in length. These terraces are more or less broken by deep rocky ravines. To the north of the one we were examining, the terraces rise still higher and more broken. The character of the summit of the mountain is, however, broad and massive, and, when once gained, easily traversed in any desired direction.

The ravine itself above our last camp soon became divided into several branches, and the ascent towards its termination, for considerable distances, exceeded 190 feet to the mile—a grade that could not be diminished by any line that we could discover, to which the labor of several days was devoted. We encamped six miles west of the point at which we reached the broad summit of the mountain, and a short distance west of the termination of the ravine examined, on the borders of a marshy, grassy pond, into which a few springs and small rills are discharged from neighboring hills. This grassy marsh—and the Sierra Nevada is covered with similar ponds—is a mile in width by two or three in length, from which we could nowhere discover water discharging. The whole mountain surface is covered with small angular stones, which in some places are packed in drifts and heaps, over which it is difficult to ride; and the steep edges of the terraces are formed by the outcropping strata which underlie the plains above. Bunch-grass is abundantly scattered over the hills, and a few branching cedar-bushes are seen. There is in no direction more than a handful of snow visible.

Several Indians, calling themselves Pah-Utahs, visited us and received small presents.

June 19.—The examination of the country already described was continued to-day, while the train and main party, under Captain Morris, moved south and west, crossing the marsh spoken of yesterday, and passing over a ridge of low rocky hills, entered Madelin Pass, the broad valley of which sweeps off to the east, encamping after a march of 9.30 miles. Smoky creek, a small stream, descends to Mud lake through the valley, which is covered with sage, grass, and stones—the soil being as light as upon the miry portions of the Basin. Latitude of camp, 40° 44′ 12″.

June 20.—We descended 7.25 miles towards Mud lake and encamped where the valley, which is ten miles wide in its broadest part above, becomes narrowed again to a mile in width, whence it continues to the eastward between hills rising and sloping back to the height of a few hundred feet. Our camp is upon one of the great terraces of the mountain. This terrace is broken in the centre to the east by deep ravines, with steep rocky walls. It is only with the greatest difficulty that our animals can travel over the light soil and rocky surface of the valley. The day has been delightful. Altitude above the sea, 4,914 feet.

June 21.—Captain Morris, Mr. Egloffstein, Mr. Snyder and myself examined the lower portion of this pass to-day. It was 13 miles to the eastern base of the Sierra Nevada, in the plain of Mud lake, to which we approached within six miles—obtaining an unobstructed view back to the point at which we turned west to leave its shore on the 16th instant. Immediately above the plain Smoky creek breaks through a mountain ridge, three miles in width at the base, in a pass varying in width from 100 to 150 yards, and at one or two narrow points not exceeding 50 yards. Its walls are of coarse, crumbling, metamorphic rocks, greatly cut and broken by small rents and side ravines. They rise, not vertically, but at points very steep, from 50 to 200 feet on the south side, and still higher on the north, swelling up, two miles back, into an elevated mountain ridge. Thick willows are in the way of passing easily up the stream, which is followed, however, by a wagon-road for a mile, which then leaves it and passes over the hills on the south side to the head of the gorge. For two miles above this point the wagon-road ascends a gently opening valley. It then leaves it, ascending a branch of Smoky creek to the southwest. The valley of the Madelin Pass at this point is half a mile in width; and a short distance above, it is a mile, but afterwards becomes a narrow ravine, with rocky walls, often vertical. On the south side the wall at once rises to the level of the terrace extending to our camp, and a railroad could only ascend that side of the pass by being cut along it; but on the north side, for seven miles above the gorge, there are no terrace walls, but the hills which set down into the valley afford a favorable site for ascending the pass. Above this point the terrace wall is found on the north side of the little valley also, but can easily be avoided in the construction of a road for which nature has already done much of the grading.

June 22.—A cool, bright day, with a gentle breeze from the southwest. The general width of the pass above our morning camp varies from four to six miles, but becomes more narrow as we approach its summit, where it does not exceed two hundred yards in width. But the hills and mountains rise gently and gradually in all parts above it, and advantage can be taken of them to increase the distance and diminish the grade of a road to a very considerable extent. It was 9.89 miles to the summit by the direct route we followed. It is broad and rocky at the summit for three-fourths of a mile, and then gradually descends for three or four miles to a broad open plain, too level for the eye to detect its inclination. Large mountain ridges and peaks rise above this plain in all directions, but are nowhere snowy. A single snowy peak and a snowy ridge, however, are seen to the northwest, considerably elevated above the intermediate range. The extensive level plain (at the head of this pass) is ten or twelve miles wide, north and south, by forty in length, east and west. The most remarkable feature in this part of the Sierra Nevada, and a conspicuous landmark, is an elevated conical peak, standing immediately on the eastern limit of this plain, and directly in the line of the Madelin Pass in ascending it from the east. The pass winds immediately around its northern base. Some of the gentlemen of the party ascended it, and were gratified with the magnificent view it afforded; of which the snowy Mount Shasta, to the west of the Sacramento, was the striking feature. Its elevation is from 2,500 to 3,000 feet above that of the summit of the pass. We encamped at the western base of this peak, at springs and meadows of grass.

The grades indicated by our barometers for the ascent of this pass from the valley of Mud lake are as follows: To the head of the gorge, 3 miles, 41.60 feet per mile; and for the succeeding 3 miles, 61.30 feet per mile; and 59.20 feet per mile for the next 2.50 miles, followed for an equal distance by a grade of 74.80 feet to the mile. The ascent for 3.56 miles above this point is but 31 feet, followed by a grade averaging 76.10 feet to the mile for 1.55 miles, and of 78.20 feet per mile for 1.56 miles; and for the succeeding 1.55 miles, 94.80 feet per mile; then for 1.56 miles, the grade is 50.60 feet per mile, followed by one of 100 feet to the mile for 1.32 miles, and of 30.30 feet per mile for 0.79 mile to the summit of the pass, the altitude of which above the sea is 5,667 feet, and the entire length of the ascent 22.89 miles; and the total difference of level between the extreme points, 1,172 feet. From the summit of the pass westward, the descent in the first two miles averages 23.50 feet per mile, and 31.80 feet per mile for the next 1.98 miles; and for 1.94 miles, 67 feet to the mile; and thence to camp, 3.85 miles, the descent averages 46 feet per mile. Day's march, 19.66 miles. Latitude of camp, 40° 48′ 46″ north.

June 23.—The train proceeded a little south of west, skirting the base of the mountains to avoid the miry banks of creeks descending into the plain, forming small grass-fields and miry marshes. Passing an isolated butte to the right, it crossed a small plain extending to the southeast and encamped, having travelled but 10.37 miles. I proceeded, at the same time, with Lieutenant Baker, Messrs. Egloffstein and Snyder, to the southeast from our morning camp to the plain just mentioned, which appeared to lead to a favorable descent to the valley of Mud lake, near its connection with Pyramid lake. Our altitude on the summit of the Sierra was 100 feet less than at the top of Madelin Pass; and for several miles below, the descent was broad and unobstructed, except by surface-rocks and stones; but the labor of riding over the miry (dry) soil so often mentioned, was severe, not only for our animals, but for ourselves. Five miles below the crest, the country became much cut up by ravines, and was falling off so rapidly, 250 feet to the mile, that we did not deem it necessary to proceed further, but ascended a rocky mass and obtained a favorable view of a route leading from the south end of Mud lake to the west, which had attracted attention when we were approaching the Sierra from the east. Descending from the mountain near us were several small streams, forming a grassy pond at the foot of the descent; and beyond this a broken ridge was followed by the pass just mentioned; still to the south of this, a high range was seen, upon which there was considerable snow.

In our outward trip we surprised several Indian families. They were much frightened at our appearance, especially the women. I invited the men to accompany us, and made them presents. On our return the women had all disappeared, but the men accompanied us to camp, where we arrived at sundown, after a ride of thirteen hours. South from our camp the mountains rise gradually, but to no considerable height. Cedar was scattered along our path to-day, rising to the height of only 40 or 50 feet, but the largest of the trees were two feet in diameter.

June 24.—I determined to cross to the west the broad plain upon which we came at the head of the Madelin Pass, and which would be followed by a railroad crossing this part of the Sierra Nevada. As before stated, this plain to the eye is entirely level, and although several small creeks flow into it and sink, no water is or can be discharged from it without (first forming a lake) overflowing at one of the numerous low gaps in the surrounding ridges. At the time of melting snows, there are many little sheets of water standing upon it for a short time, and even now it is not free from them towards the west. Its vegetation is generally sage, but a few limited meadows of grass exist on its borders. A variety of large snipe and sage-cocks are common, but we saw no evidences of larger game. On the best authenticated maps in our possession, Feather river is laid down as rising far to the north of our present position, and, in its southern course, draining the country which we are passing; and, however well we were satisfied from the formation of the country that this could not be the case, it still indicated the probability of finding a practicable descent, in the direction we were travelling, to the waters of the Sacramento; which is laid down on the maps referred to as having one of its chief sources in a snowy range of no great extent, which has been several days in sight to the northwest.

The day was bright and clear—after the passage of a storm at a distance in the morning—with the usual very high wind from the southwest. The entire march was upon the plain, passing occasionally between low hills; and we encamped near the base of more connected low ranges near the mountains surmounting the plain to the west, which are low and beautifully dark with *forests* of timber—the first we have seen in twelve months really worthy of the name. Day's march, 19.53 miles. The line of profile is direct from our camp of the 22d instant to this point; the distance (across the plain) being 21.9 miles, with but a nominal grade.

June 25.—Taking the most favorable course we could discover, we were forced still to the northwest, passing (upon the plain of yesterday) between two low spurs at first, and afterwards leaving a small lake to the left. We then entered a pass, or ravine valley, a quarter of a mile wide, smooth and gradually ascending for a mile. It then expanded to the width of a mile, and was grassy and smooth, and still rising easily; but it became narrowed to a quarter of a mile in width, and rose more considerably for the last half mile as we approached the summit. The hills or mountain ridges rise gently on either side of the ascent, and are finely rounded and grassy; and that to the left, and the whole mountain at the top of the pass, is beautifully wooded with pine, two, three, and four feet in diameter, rising in fine trunks to great heights. By winding on the hills it would be easy to increase the length of the approach somewhat, and to transfer the grade towards the lower part of the ascent, and equalise it; and the summit can easily be cut to the depth of 100 or 120 feet, diminishing the altitude to be overcome. The descent to the west is at first rapid, and the ravine narrow; but it soon opens to a much greater width, through which a creek descends, at first lazily, but afterwards, as the water increases, with a free but not rapid current. We passed with our wagons without difficulty down the slopes of spurs of the mountains projecting into the pass, having to ascend and descend these spurs in passing side ravines. The last of these spurs only deserves a remark, as it brought us nearly to the level of the top of the pass, and narrowed the valley of the creek to the width of fifty or sixty yards; but, as it was filled with bushes, it was preferable to avoid it by passing over the hill. Opposite this hill, a deep cañon from the southwest enters, with steep rocky walls. As we descended from it, we entered a valley of a mile in width, still descending considerably as we progressed.

From the summit of the pass it would be easy, for some miles, to carry a railway on the hillsides, descending at pleasure; but further down, this would become more difficult, on account of the curves which the hill ravines would require, but it is still practicable. For this purpose the northeast side is the most favorable; for, although containing the largest number of ravines, they are the smallest, and it is unbroken by cañones. The western descent of the pass is heavily timbered to near our present camp, and there is a fine warm spring, in a basin of rocks, just where we ascended the high spur to avoid the creek. We encamped before leaving the pass, after a march of 21.67 miles.

June 26.—Last night was clear and beautiful, but cool, making overcoats and fires comfortable in the evening. The morning was also bright and clear, with the thermometer at sunrise at 19° Fahrenheit—ice having formed an eighth of an inch thick. The pass again became narrow below camp, and heavily wooded for five miles, to where it opens into a broad plain called Round valley. This valley is twenty miles or more in length, and ten or twelve in width; and several creeks flow into it, and overflowing form marshy lands of large extent. It is everywhere luxuriant in grass, and the mountains around it are heavily timbered. They are not high, but gradually swelling and rolling. High mountains are seen, however, far to the north, upon which there is some snow. In the west, Mount Shasta is a beautiful feature in the landscape; and to the southwest, other beautiful snow-peaks mark the western line of the Sierra Nevada. As we entered the valley, unusually large Indian smokes curled gracefully upwards here and there, announcing the arrival of strangers.

Turning southward, we followed the base of the hills to our evening camp. Indians were seen at some distance as we were encamping, and Captain Morris rode to them and invited them to accompany him to camp. They are short, but muscular and well-made men, calling themselves Pah-Utahs. They were naked and wild, and we could comprehend but few of their signs. Their noses were bored and ornamented with a horizontal bar of shell or bone. Just above our camp was a newly-made grave, from which the earth had been removed, and the clothes stripped from the body of a young man, doubtless by the Indians, who told us that he had died but two days previously and was buried by his friends; which we subsequently learned was true, the party having been here in search of gold.

June 27.—It was 4.76 miles to the south end of Round valley, where we came upon an old emigrant road, (Lassen's) which is said to leave the Humboldt river above the point at which we crossed it, and to cross the Sierra Nevada near the southern line of Oregon, in the vicinity of Goose lake. This part of the road has also been used in travelling from Oregon to California. Its trail is well worn, but at present seldom used.

One of the main sources of the Sacramento river is in the snowy range referred to in crossing the Sierra Nevada, to the north of our path, whence it descends and enters the northeastern part of Round valley, and leaves it at our present station, where it enters a rocky cañon 100 yards wide. The river is from 30 to 40 feet wide as it enters the cañon, flowing with a free current over a bed of rocks. The walls of the cañon at its head are 80 feet high, vertical trachytic rocks at top, with a large talus at the foot.

From our camp of the 24th instant, the ascending grades upon the line explored average, for the first 10.57 miles leaving that camp, 32.70 feet per mile; and for 1.63 miles thence to the western summit of the Sierra Nevada, 92.60 feet per mile, or 26.30 feet if the deep-cut of

120 feet be deducted from the altitude of the pass, which is 5,736 feet above the sea. With the same deduction for a deep cut, the descending grades will average, for the first 2.42 miles, 124.30 feet to the mile by the fall of the stream, or 173.4 feet per mile for the same distance to the west, if the summit be passed without any cut or tunnel; succeeded, for 4.93 miles, by 55.90 feet per mile, and 125.30 feet to the mile for the next 3.67 miles, and 25.30 feet per mile for the following 2.25 miles; while the descent is but 25 feet in the succeeding 2.08 miles, but averages, for the next 1.25 miles, 76 feet per mile, and 19.70 feet per mile thence to our last camp, 8.81 miles; and from that camp to the head of the cañon, 4.76 miles, there is an ascent, by the foot-hills which we followed, to avoid soft grounds, of 27 feet. In this valley our altitude has returned very nearly to that of Great Salt lake, of the lower part of Humboldt river, and of Mud lake; being 4,154 feet above the sea at the head of the cañon.

Rising the table in which the cañon is formed, we came upon an open plain, without timber, six miles in length, by a variable width of from one to three miles, so covered with stones on the east side of the cañon that we passed over considerable mountain spurs to avoid them, and again returned to the plain near our camp. On the west side of the cañon the ground of the plain is wet, and a sheet of water stands upon it, beyond which the mountains rise a few hundred feet; while above our camp, to the east, they rise much higher, and are everywhere fertile and timbered. A single Indian, only, ventured to come to camp; but as I was anxious to learn something of the water-courses of the country from them, I made him presents, and sent him to invite others in, for the hills and plains on the opposite side of the cañon were covered by them. The women were engaged in digging roots, of which they brought us large numbers on the return of the messenger with a dozen of his comrades, who were entirely destitute of clothing, and armed with superior bows of cedar and long reed arrows, strengthened by inserting strong pieces of wood in their centres. They were short, muscular, and well-formed men, but were seriously afflicted with trembling, which they were unable to overcome entirely for several hours. This part of the Sacramento river has been heretofore termed Pitt river; and these Indians, and the bands lower down on it, are called, in California, Pitt River Indians, although they claim to be Pah-Utahs. One of them seated himself near me, and made from a fragment of quartz, with a simple piece of round bone, one end of which was semi-spherical, with a small crease in it (as if worn by a thread) the sixteenth of an inch in depth, an arrow-head, which was very sharp and piercing, and such as they use on all their arrows. The skill and rapidity with which it was made, without a blow, but by simply breaking the sharp edges with the creased bone by the strength of his hands—for the crease merely served to prevent the instrument from slipping, affording no leverage—was remarkable. After completing his work, he performed a pantomime, to inform me of the cause of his cheeks and forehead being covered with tar. He represented a man falling, and, despite his efforts to save him, trembling, growing pale, (pointing from his face to mine,) and sinking to sleep, his spirit winging its way to the skies, which he indicated by imitating with his hands the flight of a bird upwards, his body sleeping still upon the river bank, to which he pointed. The tar upon his face was his dress of mourning.

It is not practicable to descend the Sacramento river with wagons, owing to the mountainous and rocky character of its banks. I determined, therefore, to proceed with a portion of my party to the mouth of Fall river, leaving the remainder in camp until our return, and to ascend the Sacramento from its main valley to that point, after having completed our survey of the Sierra Nevada.

June 28.—We could not travel in the cañon of the river with our animals, and, to avoid a large, rocky ravine entering it from the southeast, we were obliged to leave it for some distance; and to make our day's ride shorter, attempted to cross the country directly to the mouth of Fall river, intending to return by the Sacramento. But almost immediately after leaving camp, the hills, which were high, and all the small ravines, became so rocky and covered with loose surface-stones, that it was difficult to ride over them; and our progress was effectually arrested by coming upon extensive fields of volcanic rocks, so rough and full of holes that no horseman can cross them. The Indians clamber over small portions of them, but usually avoid them even on foot. We therefore turned in towards the river, and followed its valley to the mouth of Fall river, encamping just above it. Many Indians were seen during the day at considerable distances, but fled to their hiding-places to observe our movements, leaving their flag-roots where they were digging them. The Sacramento cañon preserves the character with which it begins (at Round valley) for six miles, its walls preserving nearly a uniform height above the river. The plain is then surmounted by high, sloping hills, rising five or six hundred feet above it, and the cañon becomes broader, and its walls also more elevated for two miles, to where the river makes a large bend to the north; below this the walls gradually decrease in height, and in two miles the cañon opens to half a mile in width, which it preserves for three miles to the open valley. This open part of the cañon is timbered with oak and pine, through which the river winds, and we rode several times down its rocky banks, from the hills two hundred feet above. Below, or north of the main bend in the cañon, there are two or three angles in it, but it is generally very direct in its course. The highest parts of the cañon walls are two hundred feet above the stream, with large masses of fallen rock sloping from the stream half way to the top. The passage of this cañon by a railroad, carried generally on the terrace on the north side of the river, and descending the side of the rocky hills which surmount it, which is the most favorable line, will be both expensive and difficult; for it will be necessary to blast and remove rocks to a very considerable extent, the amount of which can only be determined by accurate surveys. The average descent of the stream per mile, for 13.74 miles, from the head of the cañon to the open valley, is 39.30 feet; but by following the north side of the river, the descent can be made much longer and easier by descending to the valley several miles further down the river, which follows the base of the mountains until it turns west, when it is overlooked by a plain, elevated 30 or 40 feet above it, extending several miles to the north. A lake of several miles in extent is seen on this plain, from the hills near our morning camp, and Fall river descends it at the base of the mountains surmounting it to the west. Below the first cañon the valley of the Sacramento is three or four miles wide, easily traversed in any direction, and as easily followed by a railroad with a descent of 27.70 feet to the mile.

Just at our camp the Sacramento is twenty yards wide, and so deep that it can only be crossed by swimming; but its current is very sluggish. Fall river descends by a short rapid of foaming white water, from the plain north of the Sacramento, and discharges more water than the latter stream. At the junction, the Sacramento immediately enters a second cañon, very much resembling the first, but of less extent. The mountains rise above it also, as they do above the former cañon, and extend back on the north side to high mountains; but on the south side, after extending some distance into the plain, they diminish in height and sink away into broken rocky hills, and are followed by an extensive field of volcanic rocks, extending through the valley of Canoe creek, or Poinsett river, to Mount Saint Joseph.

The approximate length of this cañon is 8.95 miles, with an average descent of 34.80 feet per mile. Though not so long, it is as difficult and rocky as the former to pass with a railway, and the most favorable line by which to descend it can only be determined by minute surveys. But it is probable that by leaving the river a few miles above the head of the cañon, and crossing the rocky hills south of it, and returning to the river in the vicinity of the mouth of Canoe creek, (although the grades would not be as easy and uniform,) the least labor would be required in removing rocks for its construction, and the short curves avoided, which will be encountered in descending the cañon itself, and that this will consequently be found the most favorable site for the road.

June 29.—Large numbers of Indians were gathered on the opposite bank of the river this morning, but they were evidently afraid to approach us, unless they could take us at a disadvantage, for which they have a noted reputation. At sunrise the thermometer stood at 32°, and at 11 o'clock in the morning in the shade at 80° F. The day was pleasant, but the atmosphere too smoky to afford distinct views even at short distances. Completing our observations in the vicinity of Fall river, we retraced our steps, and rejoined our companions at a late hour of the day.

By referring to my journal from July 15th to July 21st, during which we ascended the Sacramento, from Fort Reading to the second cañon, the line just traced to the latter point will be found continued to the open valley of the Sacramento, and my northern line of survey complete.

June 30.—I had been so favorably impressed with the appearance of the broad opening in the Sierra Nevada, at the south end of Mud lake, as seen from several points, that I had determined, on leaving them, to return to the eastern base of the mountains and examine it. With this object, we therefore followed the old wagon road, near which we had encamped, in a general direction for several miles to the south. It led from camp immediately over a high ridge, affording an extensive view of the mountain country around us, and of a few peaks of the Coast range, seen through low openings in the western ridge of the Sierra Nevada. But the smoky state of the atmosphere was such that no distinctive features or outlines could be traced in the distant scenery. Seven miles from camp, we entered a forest of majestic pines and cedars, through which we travelled for the remainder of the day, but with occasional open, grassy spots, on one of which we encamped after a march of 15 miles. After the high ridge noticed in the morning, the country was still hilly but easily traversed.

July 1.—Following the road again, we ascended gradually for fifteen miles over broad plains, the pine and cedar forests receiving the addition of the majestic redwood. Many of these trees were five feet in diameter, and rising to the height of 125 and 140 feet. Before encamping, we descended for three miles by a steep, rough road, to a broad, grassy plain five miles in diameter, into which several small creeks were flowing, but we could nowhere discover a certain outlet. The hills and mountains, ten or fifteen hundred feet high, surrounding this plain, with open spaces between them, are heavily timbered, with the exception of one, which is so covered with stones that no space is left for trees. Several graves near camp marked the resting-place of unfortunate emigrants. Day's march, 18.84 miles.

July 2.—We passed out by the south side of the plain to a succeeding one of less size. It was here, as before, impossible to determine which way the water flows, if, indeed, it flows at all from these plains. We have crossed them in every direction, and as yet have not seen an outlet from one of them, and some of them we have been entirely around. From the second we passed to a third of these plains, of the size of the first, in which Pine creek, a fine little stream, flows towards its northeastern part, forming a marshy pond, which can only have an outlet to Eagle lake, if at all. In this plain we also came upon a wagon-road which had been recently used, and which we subsequently learned was the Noble's Pass road, which descends to the east by the same line we were about to explore. We followed it, therefore, and leaving the plain without ascending more than a few feet, continued our course through a dense forest of pine and redwood, passing several grassy ponds, the largest of which we judged to be a mile in length. Many of the largest trees were eight feet in diameter and of great height. We descended a little before encamping, coming upon a small creek, to which emigrants have given the name of Summit, although there are points in the pass several hundred feet higher than this. In approaching camp through the woods, the road was very much obstructed by surface stones, which would have been avoided by following an open, level, grassy space leading directly from Pine to Summit creeks, a mile north of the general line of the road, which enters it, however, at our camp. It was 10.57 miles from our morning camp to Pine creek, and 9.61 thence to Summit creek.

July 3.—The nights are cold in the mountains, but during the day the sun is hot, making the shade agreeable. Our path continued to-day through the same dense forest so oftened mentioned. In leaving camp we began almost immediately to descend, and continued to do so until encamping at the eastern base of the Sierra Nevada, after a march of 19.71 miles, in

Honey Lake valley, which extends forty miles to the east. The descending road was very stony, but we nowhere saw ledges or steep escarpments of rocks, until just as we were descending to encamp, when we passed over heaps of stones forming the edge or termination of a rising plain, upon which the higher masses and peaks of the mountain are elevated. This wall is vertical in many parts, to the height of thirty feet, but broken and fallen at others. The small stream known as Susan river follows the course of a low depression seen a short distance to the south of our path throughout the day. It breaks through the rocky wall described in a broken cañon, and flows gently through the valley to Honey lake, receiving two or three small tributaries in its course. Soon after leaving our morning camp, the road led over a high rocky butte, (which it could more easily pass around,) from which we had a fine view of the lake, a few miles to the northeast. It is several miles in extent, and is set beautifully blue in the mountains, which rise from 500 to 1,000 feet above it, covered with majestic pines. It has no outlet. We gave it the name of Eagle lake. From the foot of the butte a fine spring issues and sends out a creek towards Susan river.

As we entered Honey Lake valley, we found two brothers by the name of Roop, busily engaged in erecting a log-house and planting a small field. They had been here but a month. The lands around them at the head of the valley are very susceptible of cultivation, and are luxuriantly covered with grass and abundantly supplied with water by Susan river and other small streams.

Continuing our journey still to the eastward, we encamped on the evening of the 4th of July, after a march of 23 miles, on the shore of Honey lake.

CHAPTER V.

From the valley of Mud lake, via Honey lake and Noble's Pass, to Fort Reading, at the junction of Cow creek with the Sacramento river, California—July 5 *to* 12, 1854.

From Mud to Honey and Pyramid lakes.—Honey Lake valley.—Noble's road.—Boiling springs.—Northern limit of the sources of Feather river.—Reascending the Sierra Nevada *via* Susan river.—Plain from Summit to Pine creeks.—Character of the mountain from Susan river to Pine creek.—Grades.—Broad trunk of the mountain.—From Pine creek to Black Butte creek. Grades.—Country directly west from camp on Black Butte creek; its impracticability for roads.—Ascending Black Butte creek.—Lava field.—Black Butte.—Distribution of sand.—Grades.—Hat creek.—Head of Canoe Creek valley.—Line west from Hat creek.—Crossing Wolf creek to the western summit of the Sierra Nevada.—Grades.—Western descent of the Sierra.—Battle creek.—Deer flats.—Hill's rancho.—McCumber's mill.—Shingletown.—Narrow ridge and steep descent.—Table of grades and altitudes.—Difficulties of the pass for a railroad.—Arrival at Fort Reading.

July 5.—Messrs. Egloffstein and Snyder, escorted by Lieut. Baker and a detachment of riflemen, continued the exploration eastward to-day, to connect the survey from our camp of last night with the line previously explored to the entrance of Smoky creek in the valley of Mud lake. From a mile east of camp, Honey lake trends to the southeast for ten miles, to its most eastern point, and four miles from camp the party came to the foot of a spur setting down from the northern chain of mountains, affording them a view of the country eastward. From the vicinity of this spur in the open valley of the lake, there is, extending for several miles, an old shore-line raised a few feet above the present level of the lake, but to which it occasionally rises, perhaps, at stages of high water. To the eastward of this line the valley of Honey lake extends for 14 miles, and is generally of a dry, barren character. During rains and at the season of melting snows, small sheets of water stand at short intervals here and there upon it, and at present one is seen near the lowest passage to Pyramid lake. Beyond this plain, and forming its northeastern boundary, separating it from Mud lake, is a low mountain range, varying in height from 300 to 800 feet, with a general breadth of about nine miles. In this range several indications of favorable passages exist; but upon examination they proved to be worthless, and the party proceeded southward towards the main passage around this spur to Mud lake, at a point where Pyramid lake is also separated but slightly from the former, the three being united at very high stages of water, by a small stream flowing into Pyramid lake. This passage is open and level, and in its narrowest part about a mile in width; and from the valley of Honey lake to that of Mud lake, from eight to nine miles in length, the passage to Pyramid lake branching to the south from it. From the position from which it was seen, the passage to Pyramid lake appears to cut through an elevated rocky range, with high peaks rising on either side above the vertical cañon walls. There was a line of green verdure in the cañon, but no indications could be seen of a permanent stream flowing through it. Three small islands in Pyramid lake stand opposite the mouth of the cañon, with Pyramid island in the distance. The water of this lake is remarkable for its deep-blue color, and contrasts strikingly with its yellow rocky islands.

From our camp of June 14, on the west side of Mud lake, our present camp is approached by travelling south, and crossing Smoky creek four miles below its gorge, at the entrance of the Madelin Pass, and thence continuing to the southwest end of Mud lake, and following the open passage, already described, to Honey Lake valley, and thence by the north shore of that lake by a direct line. In the accompanying profile of this pass of the Sierra Nevada, which is known as Noble's Pass, the line just indicated is followed. For three miles from the first point the descent is 13 feet to the mile; then ascends 3.60 feet to the mile for 42 miles, and 7.20 feet to the mile for the next 7.50 miles; with a descending grade thence to our present camp on Honey Lake shore, 8.50 miles, of 22.40 feet per mile—where our altitude is 4,094 feet above the sea.

In returning from their successful trip, Lieut. Baker and party halted a short time at warm springs, sixteen miles from camp; and at 10 o'clock at night, after a ride of 44 miles, encamped at a small spring of cold water, around which they found a little scattered grass. At 4 o'clock on the following morning they resumed their journey, and arrived at camp at 8 a. m.

Honey Lake valley is forty miles in length, east and west, and twenty in width. The extent of the lake itself we could not well determine, from its low shores; but it is about fifteen miles long, by eight or ten broad. It is shallow, and surrounded by low, marshy meadows, and extensive fields of tulare flags; but, outside of these marshes, the plain is firm and the travelling excellent. Its water has a disagreeable, alkaline taste. Towards the head of the valley a bold ridge rises from the plain, and extends back to a high, timbered range, rising 3,000 feet above the lake, and entirely enclosing the valley on the south. Its altitude, for many miles, is very uniform, not having a conspicuous peak upon it, nor a single break for a water-course. A few banks of snow still remain upon its summit. It extends to the east, falling off gradually to the cañon leading to Pyramid lake, and to the west of the summit of the Sierra Nevada, forming the southern chain overlooking the broad depression of Noble's Pass. To the north of Honey lake the mountains are broken, and destitute of timber; and, although connected in the eastern part, by ridges or spurs, with the Sierra Nevada, there are large depressions behind them; and the Noble's Pass road, which ascends Smoky creek for a short distance above Mud lake, passes behind them for a few miles to obtain water and grass, entering this valley over a low, broad ridge, near our camp. But the valley on the north side, towards the west, is enclosed by the main trunk of the Sierra Nevada, which rises into high peaks on the prolongation of the northern line of the valley, leaving a gradually ascending and very broad depression at its head—the line of the pass for many miles—with a few peaks rising above the general elevation, and the high, snowy peak of Mount Saint Joseph standing a conspicuous landmark on the western line of the Sierra Nevada, and overlooking the valley of the Sacramento.

Near our present camp there are fine boiling springs, in one of which a column of water, twenty inches in diameter, boils up a foot or more, at a temperature of 205° Fahrenheit; and, in the large stream which flows from it, the temperature is 170° fifty yards from the spring. Besides this, there are numerous hot springs, varying in temperature from 170° to 190°, from which gas escapes freely with the water. The rocks in the springs have a dark, volcanic character, but the surrounding masses are gray.

We had now examined every favorable indication for a pass which we could discover on the eastern slope of the Sierra Nevada in the vicinity of Mud lake; and I determined to turn my course westward again, and extend my examination of this pass to the valley of the Sacramento. It was supposed before commencing this survey, that any pass in this vicinity, leading to the summit of the Sierra Nevada, would necessarily bring us upon the waters of Feather river; but, in our several passages across these mountains, it was conclusively established that no water does, or can, enter that stream from north of the fortieth degree of north latitude, and that no pass north of Pyramid lake approaches it.

July 6.—Turning westward, we followed the valley of Honey lake, which was swarming with ducks and pelicans, and crossed Willow creek after travelling 11.36 miles—our barometers indicating, in this distance, a change of level of but fourteen feet—with an ascending grade of 11.70 feet per mile, for 8.64 miles, thence to the foot of the pass at Roop's farm, where we encamped, after a short march, on the seventh of July.

July 8.—In reascending the Sierra Nevada to-day, I followed the course of Susan river, which descends in a broken, rocky ravine; and in its lower portion its walls frequently become vertical for considerable distances, partaking exclusively of the cañon character. Seven miles above the valley it is entered by a large ravine from the southeast, but it still preserves its general course, and eventually runs out. It is frequently broken throughout its entire length by small side ravines, and is generally narrow at the bottom and broad at the top; but, for short distances, it is alternately broad and narrow at the top and bottom. For the first three or four miles above the valley, the ravine is from two hundred to two hundred and fifty feet deep, but above that it seldom exceeds forty feet, except where small ridges, or spurs, approach it, when its walls become much higher, but are less vertical. After ascending it for eight miles, we crossed it, and ascended an elevated peak near it. The position of this peak was favorable for observation; but we could nowhere discover a route superior, or at all equal, to the one we were following, for a railroad to ascend this pass. Continuing our examination, therefore, we ascended the stream for four miles on its southern bank, to where it again receives a considerable branch from the southwest, and two small ones from the opposite side. But it was here rapidly running out; and a short distance above, the main stream descends in a channel but slightly depressed below the surface of the broad mountain plain which we were approaching. Passing again to the north side of the stream, we ascended it a short distance, and then crossed over and encamped with the main party, which had followed the road, on Summit creek, at our former camp of July 2.

July 9.—In leaving camp this morning, I followed the open, grassy plain, lying between Summit and Pine creeks, while Mr. Egloffstein proceeded with a party down the former stream until it disappeared in the plain; and then crossed over, without any material change of level, to the head of Susan river; and thence continued our line of yesterday, from Susan river by the ascending plain to Pine creek. This portion of the mountain is unobstructed by any sudden rise or fall, and can be traversed for several miles in any desired direction without obstruction. It will require a minute survey of the lower portion of this pass, to determine the best line by which to effect its ascent by a railroad; whether by ascending the ravine of the river, by which the grade is comparatively small, or by rising as soon as possible to the top of the ravine, with a heavier grade, thereby avoiding, to a considerable extent, the expensive labor of removing rocks for its passage. It is believed to be practicable to accomplish either. The ascending grades by the river, from Roop's farm, are, for the first four miles, an average of 10.10 feet to the mile; and for the next four miles, 105.50 feet to the mile; then 59.10 feet to the mile for 4.50 miles; and for the next 7.25 miles, after leaving Susan river, 75.10 feet to the mile; followed by 31.10 feet to the mile for 7.25 miles, and 54.30 feet per mile for 2.25 miles; with a descending grade of 27.70 feet per mile for five miles, to the west side of Pine creek. From Pine creek we passed through the open pine woods, and, bearing to the left, followed a grassy plain, gradually descending for 4.73 miles, with a high ridge on our left, which we continued to pass around, changing our course more to the south as we progressed. This prairie was from one to three miles wide, and was marshy in the southwestern part, where it terminates. Leaving it, we again entered a heavily timbered district, descending considerably for 3.75 miles, when we came again into an open prairie, and encamped on Black Butte creek—a small stream, three feet wide, flowing a little to the west of north, and eventually disappearing in the plain. The characteristic feature of the country traversed to-day is the broad trunk of the mountain—the plains which we are following—surmounted by elevated peaks and ridges, having no uniform direction, and with elevations varying from five hundred to three thousand feet above the plains, with drifts of snow only upon the most elevated peaks. From west of Pine creek to this camp the average natural grades, given by our barometers, are, for the first 2.89 miles, a descent of 63.20 feet to the mile; and 19.50 feet per mile for the following 1.84 miles; and 71.90 feet per mile for the next 1.70 miles; and 64.90 feet per mile for 2.05 miles; and 113 feet per mile for 1.55 miles thence to camp, where our altitude is 5,084 feet above the sea.

July 10.—From our last camp the road ascends Black Butte creek, which, for several miles, descends a broad valley, enclosed by high, rolling mountains to the northwest, and a more abrupt, but less elevated ridge, to the southeast. But to the west of that camp, passing north of the first-mentioned mountains, the view is unobstructed, except by timber. I therefore divided my party, examining the more southern route by the creek myself, and directing Mr. Egloffstein to pursue a general western course, by the most favorable route he could discover, to the most western ridge of the mountains. He proceeded through the dense pine forest, gradually ascending, but without obstruction, for five miles, but immediately afterwards came upon a precipitous rocky descent, increasing in height to the south, where it unites with the elevated mountain in that direction, and extending to the north far into the valley of the Sacramento towards Fall river, and nowhere presenting a practicable point for the descent of a wagon-road even, and much less of a railroad; and it was only after the most persevering efforts, and repeated failures, that he succeeded in effecting the descent with his party—descending 967 feet at an angle of nearly forty-five degrees, into the large, rocky valley of Canoe creek. This valley extends north to the Sacramento, and in some parts is several miles broad, but in others narrow; and is occupied, at intervals, by extensive beds of volcanic rocks, with intervening grassy spaces and pine forests, in which game is very abundant. Two considerable creeks enter it at its head, from the vicinity of Mount Saint Joseph, and unite to form Canoe creek; but it is probable that this stream sinks and reappears several times in its rocky course before reaching the Sacramento. For three miles up Black Butte creek our route followed immediately upon the banks of the stream, and thence followed the open, rolling pine woods, for 5.90 miles, to where the creek descends from high hills to the south. For several miles of this ascent the ground was covered with black, cindery sand, thin at first, but becoming very heavy as we progressed.

After leaving the creek we passed two or three small ponds, and entered one of the most recently formed and strongly marked volcanic fields we have seen in these mountains. It occupies a valley of three or four miles in length, by one or one and a half in width. The lava rocks are black, and about 100 feet high, occupying the valley in a confused mass, which it would be difficult to cross on foot. On the north side of this field stands the Black Butte, some 800 or 1,000 feet high. It is conical from its base upwards for several hundred feet, and is terminated in a peak with a semi-spherical outline; and its whole surface, as black as the darkest iron ore, is covered with a coarse, pebbly sand, formed from its crumbling mass, which has so smoothed its surface that a pebble would roll from its summit uninterruptedly to its base. The sand over which we approached this butte is uniformly distributed around it, as from a central crater, becoming thin towards the edges, and then disappearing. The width of the valley of Black Butte creek, and the broad, ascending base of the range enclosing it to the northwest, are such, that, in the construction of a railway, they will admit of a uniform grade, which will necessarily be heavy until passing the Black Butte, or for twelve miles. The road should ascend by the line indicated, for nine miles, to the small ponds at the foot of the lava-field; and thence be continued to the south and west, passing around it, and, returning northward, pass a short distance to the west of Black Butte. This line will increase the distance and improve the grade given in the profile. The distance from our morning camp to this point, by the road, is 11.69 miles, and the average grade 101.80 feet to the mile; and the greatest distance which could be gained, would not probably diminish it below 80 feet to the mile. From the point thus gained, in a broad depression, west for 1.87 miles, the descent is 25.10 feet per mile; and 19 feet per mile thence for 1.53 miles to the west, to a small spring; with an ascent of 5.80 feet per mile for 3.75 miles, to where the road should cross Hat creek. This point is reached by following the present emigrant road, west of the little springs just mentioned, until it reaches the head of Canoe Creek valley, where, instead of descending into that valley, following the wagon road, a railroad can only be continued to the west by bearing a little to the south and ascending the stream, to which there is no obstruction, for a mile, and crossing it at the point already designated, where the valley of the stream is on a level with the approach to it. Immediately west of this creek a spur from Mount Saint Joseph—which stands but a few miles to the south of this pass—extends a short distance into Canoe Creek valley; and is followed to the west by the narrow valley of Wolf creek, immediately beyond which the most western ridge of the Sierra Nevada rises. The spur between the streams is heavily timbered, but more or less rocky, and falls off rapidly to the north, affording the means of passing it by almost any desired line. It is, however, more or less broken by small ravines of an ordinary character. The valley, or ravine, of Wolf creek is narrow and deep, but can be readily passed by ascending its eastern side nearly to its head, and crossing a deep, dry ravine on the spur, and following it until reaching the creek, whence the road should be carried immediately along the side of the rocky, timbered ridge to the west, to the western crest of the Sierra Nevada. The average grades by this line from Hat creek, are, for 2.75 miles, 45.10 feet per mile; and 154.4 feet per mile for 0.50 mile; and 21.30 feet per mile for 1.50 miles, to Wolf creek; with an ascending grade of 45.50 feet per mile for two miles thence to the western summit of the pass. The side of the mountain, from Wolf creek to this summit, is broken by two or three large ravines, and, besides being covered with surface-rocks, large ledges crop out at various points upon it. The summit depression of the pass itself is three-fourths of a mile broad towards the east, and very soon expands to two miles—a high, round peak, destitute of timber, rising to the north to the height of 300 feet; and, to the south and east, steep, rocky peaks and masses rise towards Mount Saint Joseph, (sometimes called Lassen's Peak,) which is three or four miles distant, and covered with snow from its summit downwards for a thousand feet. We encamped on Wolf creek, two miles east of the summit. Day's march, 20.34 miles.

July 11.—We returned to the summit of the pass, which is covered with immense heaps of broken stones, covering miles of surface, like rubbish from a quarry, but so level that water stands upon it in various places for half a mile, and it is lightly timbered. Its approximate altitude is 6,074 feet above the sea. The descent from it to the valley of the Sacramento is unobstructed, and, unfortunately, very direct. For five miles from the summit about half of the descending plain or broad ridge is timbered, and the open portion covered with a dense thicket of mansanita bushes. Unfortunately for us, on both occasions on which we passed this summit, (we repassed here on the 25th of July,) the view of the mountains for any considerable distance below us was obscured by a smoky atmosphere, and the valley of the Sacramento entirely invisible from the dark cloud of smoke which hung over it, over which, however, as over a blue sea, peaks of the Coast range were occasionally visible. The plain of descent widened rapidly at first, as we descended, and four miles from the summit we judged it to be four miles in width, limited on the south by the deep ravine of Battle creek, (descending from Mount Saint Joseph,) which, however, soon runs out into the general level of the descent, and broken on the north by a formidable dry ravine commencing near the foot of the rubbish heaps at the summit, and extending several miles, and numerously intersected by ordinary ravines. Coming upon Battle creek, the road descends it for a short distance, and crosses it where it bends to the northwest, the road continuing its direct course, and entering a dense forest of pine, cedar and redwood. The mountain continued to fall off rapidly, and we made short, steep descents for a few hundred yards at a time, as from successive terraces. But after crossing the creek there is a deep ravine seen 3.50 miles to the southwest of the road, and nearly parallel with it, marking the southern slopes of the level intervening space between Battle creek and one of its tributaries, which descends from the south side of Mount Saint Joseph. This space is embraced in the general plain of descent, and considerably increases its width, affording the means, by its uniform character, for continuing the curves of a railway in any desired direction to the south of Deer Flat, nine miles from the summit, where a small farm is established on a few acres of open prairie, and thence to Hill's rancho, 3.69 miles below, on Battle creek, where the descent for much of the distance is imperceptible. Crossing the creek, we continued on through the same dense forest, interspersed with large branching oaks, across the most favorable and perfectly practicable section of the pass, and encamped near McCumber's mill, 8.72 miles below.

In the early part of the day the road was very much obstructed by loose stones, but for the last fifteen miles it was very fine. Many of the pines were from four to six feet in diameter, and from one hundred to one hundred and fifty feet high. Several mills are in successful operation in the vicinity, and others are being built. Day's march, 23 miles.

July 12.—For two and a quarter miles this morning—passing through Shingletown—the descent was scarcely perceptible; but the country there becomes more broken, and formidable hollows and ravines extend from the road north to Bear creek—which before lay considerably to the north of the line of descent—rendering the winding of a road in that direction quite impossible. The country also became more broken to the south, towards Battle creek, leaving comparatively a narrow ridge upon which to effect a descent to the foot of the mountains. The distance between the streams themselves is about 4.25 miles at this point, and is not only broken by the large hollows referred to, but the remaining portion of it, 1.25 miles wide, the most favorable line and greatest width which we could discover for the construction of a railway on this part of the descent, falls off rapidly and is very broken, and intersected by broad and deep ravines, especially outside of the narrow ridge followed by the present wagon road. This narrow ridge continues for four miles, but the descent is still rapid for seven miles further, and the country broken into narrow ridges descending to the west, yet there is much greater room for increasing the distance and overcoming the descent. The country is here no longer a forest, but a broken and open oak prairie, dry and parched at this season of the year, but very soft and miry during the rainy season. Forty miles below the summit we were passing the lowest foot-hills of the mountains, and were fairly in the open valley of the Sacramento river. The heat increased with our descent, the thermometer standing, in the shade at 3 o'clock p. m., at 106° Fahrenheit. We continued on, however, and encamped, after a march of 23.72 miles, at Fort Reading, on the west side of Cow creek, a mile and a half above its junction with the Sacramento.

Table of approximate average grades, in descending by a very direct line from the western summit of Noble's Pass of the Sierra Nevada to the Sacramento river.

Stations.	Intermediate distances.	Total distances.	Average descent per mile in feet.	Altitudes above the sea in feet.	Remarks.
Summit	....	....	....	6, 074	
Battle creek	5. 00	5. 00	49. 80	5, 825	
	2. 50	7. 50	212. 60		
	2. 12	9. 62	284. 00		
Deer Flat	2. 14	11. 76	174. 50	4, 318	
	1. 69	13. 45	101. 70		
Hill's rancho	2. 00	15. 45	7. 35	4, 131	
	4. 14	19. 59	47. 60		
	3. 58	23. 17	136. 60		
McCumber's mill	1. 00	24. 17	54. 60	3, 491	Camp.
	2. 38	26. 55	2. 80		
	3. 05	29. 60	230. 10		
	2. 19	31. 79	235. 50		
	3. 78	35. 57	186. 20		
	2. 93	38. 50	166. 90		
	2. 54	40. 04	78. 80		
	4. 37	45. 41	41. 40		
Fort Reading	2. 25	47. 66	14. 10	674	
					Total descent 5, 400 feet.

In the preceding table and the profile of Noble's Pass, accompanying this report, for the first five miles from the summit I have given the longest line of descent which can be obtained (the direct line being but three miles) by winding from the summit of the pass south along the foot of the nearest peaks, and touching Battle creek. Below this, the distances and line of profile are those of the direct line of descent; for the total descent, 5,400 feet—5,000 being confined to the first forty miles of the direct line—is so much more unequally distributed than was anticipated when making the survey, that, at two points it is not practicable, without a minute survey and actual location of the road, to indicate a continuous line upon which a railway can be successfully constructed to descend this pass; and I have, therefore, not deviated from the direct line. But it can only be carried below the point indicated on Battle creek by continuing the curve and crossing to the north the deep ravine before referred to, and again re-crossing it on a curve to the south, returning to and across Battle creek, and thence, by a continued series of similar curves, effecting the descent. The width of the descending ridge is so great, and its general character such, however, as to establish the strongest probability of the practicability of effecting the descent on large and practicable curves to Hill's rancho; and there is no difficulty in continuing it thence to McCumber's mill—24 miles (including the curve for the first five miles) from the summit. From this point the road should follow, for some distance, a branch of Battle creek to the south, relieving, as far as practicable, the difficult section below Shingletown; for the broken narrow ridge by which the descent must be continued for four miles below this point is such, and the descent so great, as to render it doubtful whether it can be successfully descended without stationary power. A further survey and actual location of the road, as before indicated, is, however, necessary to determine this point. And if the general character and location of the route connecting with this pass is such as to render the determination of this point desirable, the resurvey should be continued to the summit of the pass.

The section immediately succeeding the one just indicated is that of the foot-hills of the mountains; and is rough, descending in narrow ridges, but a railway can readily be carried over it.

We were courteously received at Fort Reading by the commanding officer, Colonel Wright, and the other officers of the post, and hospitably entertained by them during the two days which we were detained in getting our animals shod and procuring necessary supplies for our trip up the Sacramento to the mouth of Fall river, to complete the line of exploration by the Madelin Pass.

CHAPTER VI.

Ascent of the Sacramento river from Fort Reading to the mouth of Fall river, (line of the Madelin Pass,) and thence by the valley of Canoe creek to Noble's Pass, and return to Fort Reading—July 15 *to* 26, 1854.

Character of the Sacramento valley above Fort Reading.—Mining village.—Sacramento river enclosed by mountains; its character.—Trail to Yreka.—Stream known as the Sacramento.—McCloud's Fork.—Salmon.—Pittsburg ferries.—Snows and freshets.—Ascent of the river.—Rapids.—Hot spring.—Re-ascent of mountain.—River still shut in by precipitous mountains.—Valley at the mouth of Canoe creek.—Second cañon of the Sacramento; its character.—Table of grades from Fall river to Fort Reading.—Completion of the survey of Madelin Pass.—Return to Black Butte creek, Noble's Pass.—Numbers of Indians daily seen.—Fields of lava.—Valley of Canoe creek; difficulty of its passage.—Disappointed in the course of Black Butte creek.—Night march.—Return to Fort Reading.—Sacramento valley.—Party disbanded.

July 15.—Leaving Fort Reading, we ascended the valley of the Sacramento, by a general course a little west of north, passing over a hilly country of open oak prairie for sixteen miles, and encamped without reaching the river, which is a few miles to the west of our path. For several miles above the Fort the valley of the river is an open, rolling prairie, more or less timbered with oak and a small growth of pine. The general level of the country is, however, elevated above the immediate plain of the river banks, and is broken by dry ravines and hills, which continue to rise as they recede from the stream, and are eventually united to the great mountain masses which entirely enclose the head of the valley, and shut in the river from immediately west of our present camp upwards to the mouth of Fall river.

July 16.—Five miles from camp, this morning, we came to a small mining village called Churntown. It consists merely of a dozen miserable log-huts, and being badly supplied with water at this season of the year, is in a thriftless condition. The day, too, was intensely hot, and the men had everywhere thrown by their tools—not a man being seen at work. It was four miles from this village to the Sacramento river, directly north, and its mountainous position cannot better be illustrated, perhaps, than by the fact, that the stream or rivulet which supplies Churntown with water rises but a mile from the river, but instead of flowing north towards it, it descends in the opposite direction, and enters it below our last night's camp. From the head of this creek we descended by a very steep Indian trail directly to the river, where it is two hundred feet wide, flowing with a very rapid, powerful current, and, with the exception of short distances here and there, breaking over a rocky bed. In seasons of high water it sends down immense volumes, the drift being ten and fifteen feet above the present stream. The mountains rise abruptly from the river banks to the height of eight and ten hundred feet. They are timbered with pine and oak near the river, but rocky ledges slope down to the water's edge; and it is, at intervals, impossible to ride along the Indian trails which lead over the water-washed drifts and heaps of rocks lying on the banks. At points where rocky strata crop out on the river banks, the Indians themselves are forced more or less to ascend the side of the mountain in travelling up and down the river, and in many instances, to avoid long bends of the stream, pass over the projecting spurs. In its mountain course the river is winding; but in its general direction in this part, it descends from a little east of north, and continues it a short distance below our present position, when it changes more to the south and eventually a little to the east, as it enters the open valley below. We began its ascent by riding, when we could, on the trails, but were frequently forced to leave them and pass over spurs, up which our animals could not carry us, and we suffered greatly from the intense heat of the day.

The river is followed on the opposite bank by a heavy pack-trail leading to Yreka; but it soon leaves the main river, and follows the course of an affluent from the north, which has been generally mistaken for the Sacramento itself. It is, however, but a small stream compared with the main river, to which the name of Pitt has been given. Six miles above the mouth of this stream we came to the mouth of McCloud's fork, a larger stream than the former, also entering the Sacramento from the north. Salmon abound in this stream, and in the Sacramento, but far more abundantly below this junction than above it. The stream was lined with Indians, many of whom were entirely naked, while others were provided with a single garment, or had their faces blackened with tar in mourning for their friends—the tribe having been recently severely punished by the neighboring miners and settlers, whose friends had been killed by them. From McCloud's fork, two of them accompanied us to our evening camp, 5.25 miles above, which we reached at dark, drenched with perspiration, our animals trembling with heat and fatigue. At this point there is, on the south side of the river, a small grassy prairie a few hundred yards wide, and a ferry is established by a Mr. Dribblesby for the use of a mining town, three miles to the north, called Pittsburg. The river, for a mile opposite this prairie, flows with a gentle, unbroken current; but at its foot makes a short bend, and desends rapidly over its rocky bed. I purchased from one of the Indian women, to-day, a girdle of the size of an ordinary rope, made entirely of human hair. Day's march, 24 miles.

July 17.—We rode on the bank of the river, this morning, for two miles to Silverthorn's ferry, and were then driven high up the mountain to avoid deep ravines, and to pass around ledges and masses of fallen rocks found at a few points—the mountains dividing the valley of Cow creek, which we occasionally overlooked at a distance, from the river immediately below us. The character of the river was the same to-day as yesterday, curving among the high hills and mountains. The timber of the forests was also the same, and the character of the hard, dark, trachytic rocks unchanged. Indian smokes curled upwards from every part of the mountains where they were engaged in burning the grass to catch grasshoppers, upon which they feed, regarding them as a great delicacy. We encamped on a small flat, 200 yards wide and a mile long, on the river bank, 10.50 miles above our morning camp. From the most reliable information we could gain from persons who have lived on the river for two or three years past, the amount of snow which falls upon the higher parts of the mountains is large; but upon the river itself it is small, never exceeding four or five inches in depth. They also state, that upon the river banks, which are completely sheltered from the winds, it never accumulates in drifts, being deposited on the sheltered sides of the mountains long before reaching the stream. They state, also, that the river is never choked up with ice, but that it rises ten feet above its general level in times of great freshets.

July 18.—Clambering along the mountain sides, we again returned to the river 4.70 miles above our morning camp; and in passing a rocky point several mules were crowded into it, and swam with their packs to the opposite bank. And in addition to previous difficulties encountered in following the river banks, it was obstructed by dense thickets of bushes and fallen trees lying at right angles to our path. But to ascend the mountain sides, and pass along where we could observe the character of the river, was also very difficult, and several of our animals repeatedly lost their footing and rolled back hundreds of feet, in passing the steepest points. We were constantly in positions to overlook the river, but did not again descend to it during the day, its character remaining entirely the same. The mountains, however, became higher, and the ravines longer. We encamped, after a march of but 11 miles, at the head of a ravine, where we found a small spring and a little grass in the open pine and oak forest.

July 19.—We returned again to the edge of the mountains overlooking the river, and at 9 o'clock a. m. again descended to it, hoping to be able to follow it; but we here found it more confined by rocky ledges than in any other part of its course, the ledges being, at some points, quite vertical on alternate sides of the river. The ravines, too, were more rocky and precipitous than before, and we were forced, after examining it, to retrace our steps for nearly a mile, when we again turned up the river, and crossed two or three small streams, gaining a position from which we overlooked it for several miles, both above and below, but we could discover no improvement in its character: our course, however, changed to nearly due north, parallel with the river, and but a short distance from it. The summit of the mountain was broad and level, and the timber unusually heavy, and a fine growth of raspberries reminded us of our boyish days. At the end of this direct course, we again descended to the river, and found it a foaming rapid for several miles above its change of course. Its fall here is twice as great as in its general descent. Just above its change of course there is a small boiling spring, the stream from which immediately falls into the river. Above this spring there is a rocky valley, half a mile wide, timbered with oak, in which we encamped after a march of 23.50 miles. The mountains passed to-day were more elevated than those crossed yesterday, but were not so difficult to traverse.

July 20.—We followed the rough bank of the river, this morning, for 7.50 miles. On the side of the trail there was something like a valley, uneven and rocky, but it soon became rough and broken; and the mountains, eventually shutting in close to the stream, were too steep, and too much obstructed by fallen timber and dense thickets of bushes, to admit of further progress along its shores. The opposite bank was, at the same time, more than usually steep and rocky, and at some points almost vertical. There was no alternative, therefore, for us but to re-ascend the mountains; for, with our force, we could not have progressed three miles a day by cutting a road along the mountain base. The ascent was very steep and difficult, and we were occupied four hours and a half in effecting it. And when we had gained the summit, which we followed for some miles high above the stream, which could be traced by its foaming current, not only where we were passing to-day, but at the foot of the long line of the heavily timbered summit followed yesterday, we encountered such a dense growth of mansanita and laurel bushes that it was only by the most persevering efforts that we could effect a passage through them. Steep ravines extend from the river quite to the summit of the mountains, and we were always forced to pass around them. Coming eventually, however, to an open woods, we pushed rapidly forward, and at sundown came upon an open, grassy prairie, abundantly supplied with water. This was the first grass we had seen during the day's march of 18.50 miles, and was a most welcome sight.

July 21.—We passed directly over the crest of the mountains towards the river, to points where we could overlook it immediately at our feet. For several miles below us its banks were as high and rocky as at any point below; but immediately in front of us, and for a short distance above, with one exception, the projecting ridges or angles were low, and for short distances one could ride comfortably along the base of the mountains. The river was, however, still shut in by mountains, and its current was as rapid as ever. But the mountains were so broken by ravines that we could not pass along them, and were obliged to recross the summit, where we at once came upon a more level country, but very rocky and dry. The mountains on the river also began immediately to fall off, and we easily returned to it a short distance below the mouth of Canoe creek, where there is a small valley extending for five miles along the river. This valley is a mile wide only, but the mountains above are low and retreating. Canoe creek is sixty feet wide at its mouth, with a current as rapid as that of the Sacramento. The Indians have large fish-traps arranged in it, but the salmon season has not yet arrived. Crossing the creek we ascended to the head of this valley, passing several holes dug by parties searching for gold; and at the head of the valley reached the foot of the cañon, before described as the second cañon of the Sacramento, immediately below the mouth of Fall river. The walls at the lower end are higher, but much less vertical than at the upper end of this cañon; and the accumulated mass of fallen rocks extends from the water nearly to the top. It is much wider also at the lower than at the upper end; and the peaks rising on the terrace above, sloping gently back, are less elevated. It is, however, a formidable cañon, cut deep through strata of trachytic rocks; and in descending the Sacramento with a railway, as before stated, it will be a point, which can only be determined by a minute survey, whether it will be easier to pass around it to the south, over the lava fields at the foot of the ridge or butte which rises on that side of the cañon, and return to the river at the mouth of Canoe creek, than to descend by the cañon itself.

Table of approximate average grades in descending the Sacramento river, from the mouth of Fall river to the head of steamboat navigation at Fort Reading, California.

Stations.	Intermediate distances.	Total distances.	Average descent per mile in feet.	Altitude above the sea in feet.	Remarks.
Mouth of Fall river...	....	....	....	3,249	Head of second cañon
Foot of second cañon.	8.95	8.95	35.00		
Mouth of Canoe creek.	4.70	13.65	14.00		
Sacramento river.....	22.50	36.15	30.70		
Sacramento rapids ...	7.50	43.65	59.60	1,730	
Sacramento river.....	26.50	70.15	21.70	1,156	
	4.70	74.85	16.60	1,078	
	10.50	85.30	11.80	954	
McCloud's Fork......	5.25	90.55	6.10	922	
Sacramento river.....	11.75	102.30	7.20	837	
Fort Reading........	22.90	125.20	7.10	674	

Having completed, by this connection, my exploration of the line of the Madelin Pass entirely through to the head of steamboat navigation on the Sacramento, we turned our course towards the south to explore the country drained by Canoe creek, and, if possible, discover a route connecting the Sacramento, at the mouth of that creek, with Noble's Pass at Black Butte creek, where the emigrant road first strikes it in crossing the mountains from the east, by which, if no better route could be found, the steep descent from that pass to the west would be avoided.

The ascent of this creek for the first mile led us over thorny bushes and rocky bluffs; and in their passage we were greatly aided by a heavy Indian trail, always serviceable when available, and here doubly acceptable, for our animals were both jaded and sore-footed from constantly travelling on the sharp angular fragments of rocks. For the first mile, also, the stream was full of foaming rapids at short intervals; but above that point we came to an open grassy prairie of small extent, through which the stream flows gently, and in its passage receives two or three respectable tributaries, one of which, from the southwest, falls with considerable noise into the main stream. We encamped under a wide branching pine in the centre of this prairie.

July 22.—Just above our morning camp we ascended a terrace wall, fifty or sixty feet high, to a nearly level plain, upon which we followed an Indian trail for two miles. This plain was covered in various parts with grassy ponds, but it was obstructed to the southeast and east by large fields and hills of volcanic rocks, with dark ledges and masses here and there, and it was apparently impassable. To the west there was an open pine woods and a low range of hills, apparently succeeded by another plain, upon which there is a lake called Freaner, the name of an unfortunate gentleman who is supposed to have been killed by the Indians in its vicinity. Many Indians were daily seen in every part of the mountains, but they invariably fled upon seeing us. Dismounting from our animals, we determined to attempt the passage of the field of lava (pedrigal) to a high bluff beyond; but the path was so bad that many of them could not be led, and we were obliged to remount, and in two miles succeeded in extricating ourselves from it by the most difficult path I have ever seen. Ascending the bluff, the red soil of which was friable and dusty, we still found a stony path, but it afforded us an extensive view of the country for many miles, overlooking the Sacramento and Fall rivers, and the valley of Canoe creek. Here, as above, the valley of Canoe creek is but a few miles wide, and is almost entirely occupied by fields of volcanic rocks—the part we had crossed being but a small angle of it. The course of Hat creek, which enters it at its head, could nowhere be traced, and it is probable that it occasionally disappears among the open rocks of the valley, and again reappears when no longer finding a subterranean passage. Our course continued along the bluff, which is broken by deep ravines, and is the same that Mr. Egloffstein encountered in crossing to the west from Black Butte creek on the 10th instant, and by which we hoped to reach that stream, as it was supposed to be an affluent of Canoe creek, and it was near night when we reached the base of the mountains south and west of our former camp on that stream without finding it, or, indeed, any but the most trifling amounts of water in springy places; and as the country to the north, to the line we followed in our trip to the mouth of Fall river, was overlooked by us all day, and we could nowhere discover any indication of a stream, we came to the conclusion that, like most of the streams we have seen in these mountains, Black Butte creek sinks in some of the grassy plains before reaching the river. We were therefore obliged to turn eastward to find a suitable camp, and were soon overtaken by night in a dense forest, obstructed by a thick undergrowth, ledges of rocks, and fallen timber. But I determined, notwithstanding these difficulties, and that there was no trail—the stars being visible, however, through the pines—to proceed to our former camp on Black Butte creek. But as I could not see the ground, even when on foot, I owed my determination entirely to the confidence I had in my mule to conduct the party safely through. I gave her a loose rein, only occasionally bringing her back to the proper course when forced from it by insurmountable obstacles, and the men set up a merry song to enable them to follow each other; but it was not until 11 o'clock at night that we emerged safely from the forest at our former camp, after a most laborious ride of 35 miles upon which we were engaged for fifteen hours. We had failed, however, in finding a route by which to descend with a railroad from this point to the mouth of Canoe creek, having traversed a rough, broken country, and encountered abrupt descents, which we could discover no means of avoiding.

From this point we returned to Fort Reading, re-examining the most difficult parts of Noble's Pass to the west, the result of which is embraced in the report already given of that pass, where we arrived on the 26th of July, and were kindly received by our friends. Fort Reading is in latitude 40° 30′ 02″, and by the course of the river about 300 miles from the sea, but only 200 or 220 by the direct course of the valley, and, as indicated by our barometers, 674 feet above it. The valley of the Sacramento is here from ten to fifteen miles wide, but is more or less occupied by the foot-hills of the Sierra Nevada on the east, and of the Coast range on the west, and these hills occasionally extend in bluffs, of sixty and a hundred feet in height, quite to the river banks; but they become much less frequent as we descend, and eventually entirely disappear near the river, and the valley becomes wider, more open, and level. It is occupied in various parts, throughout its whole extent, by extensive farms and flourishing settlements, and is well known to be finely adapted to the construction of a railway.

Having thus connected my line of survey with this valley by the most practicable route, as required by your instructions, I at once disbanded my party, and reported to you in person, in this city, on the 12th of September.

CHAPTER VII.

General Summary and railroad practicability of the line explored on the forty-first parallel of north latitude.

Railroad connexion east from Fort Bridger.—Valley of Green river.—Grazing cattle in winter in the mountains.—Mormon settlement on Smith's Fork.—Bear River, Wahsatch, and Uinta mountains.—Highest point of the line reached.—Appearance of the country thence west.—Depth of snow.—Timber, soil, and grass.—Length of line from Smith's Fork to Oquirrh mountain.—Cañones of the Weber and Timpanogos rivers.—Railroad in the Jordan, Tuilla, and Lone Rock valleys.—Mormons desirous to aid in the construction of the road; their numbers.—Cedar mountain.—The Desert.—Passages to the south of Pilot Peak, and thence to the Humboldt mountains.—Humboldt Mountain Pass; its altitude.—Timber and its abundance.—Valley of the Humboldt river.—Country south of this valley; its profile.—From Humboldt river to the foot of the Sierra Nevada.—Fertility of this section.—The ascent of Madelin Pass; its altitude; broad plain at its summit.—Highest point of the pass; its western descent; timber, and soil.—Round valley.—Sacramento river.—First cañon of the Sacramento.—Second cañon of the Sacramento.—The Sacramento below the mouth of Fall river.—Noble's Pass of the Sierra Nevada.—Mud lakes to Honey lake.—Honey Lake valley.—Ascent of the mountains.—Susan river.—Pine creek.—Black Butte creek.—Black Butte.—Hat and Wolf creeks.—Greatest altitude in this pass.—Descent from the western summit of the Sierra.—Depth of snow in the winter in this pass.—Dr. Wozencraft's observations.—Entire length of the pass.—Head of steamboat navigation of the Sacramento.—Future surveys.—Method of determining levels.—Building-stone upon the route.—Water.—Cultivable land.—Directness of this line; its length.

Having concluded the journal report of my explorations for the Pacific railroad, of what may, very properly, be designated the route of the forty-first parallel of north latitude, which is both central, as regards its geographical position and its connection with the general lines of commerce of all parts of our country, the general features of the route explored, and its adaptation to the particular object of its examination, will be succinctly presented.

This route is intended to connect, in the vicinity of Fort Bridger, in the valley of Green river, Utah, with that explored thence eastward by Bridger's Pass to the Plains, by Captain Stansbury, in returning from his survey of Great Salt lake, in 1850; and it is only necessary that I should refer you to his report of that part of the route for its clear understanding, and connections thence eastward with the general lines of commerce of the country, either by descending Lodge Pole creek, the South fork, and main Platte, to the Missouri, or by keeping to the east of Crow creek and passing over to the Republican fork of the Kansas, and descending the former stream to its junction with the latter, and thence pursuing any desired route to the Missouri.

That part of the valley of Green river in which Fort Bridger is situated, and which is overlooked from the foot of the Uinta mountains by the line which we followed in our explorations eastward from Bear river, constitutes a remarkable feature upon this line. It has been variously designated as the valley of Green river, the Green River Basin, and the Coal Basin of Green river, from being abundantly supplied with that important article. It is more than two hundred miles in extent from east to west, and has a variable width, north and south, from twenty to over a hundred miles. It is enclosed on the east by the Rocky mountains, and on the northeast by the Sweet Water and Wind River mountains—Green river entering it from the north—and on the northwest and west by the Bear River mountains; and on the south by the Uinta mountains, broken by the deep cañon by which Green river continues its course to the south. Its borders are occupied by spurs from the surrounding mountains, and a few detached buttes are seen east of Green river; but its general character is that of an elevated rolling plain or valley, easily traversed in any direction. It is drained by Green river, which passes southward through its centre, and by its tributaries. Its soil is light and dry, with a small scattered growth of cedar upon the mountains, and borders of grass are found upon its water-courses; but artemisia, with a little scattered grass, occupies the valley in every direction, and characterizes its vegetation. The trading post at Fort Bridger has been occupied constantly for the last ten years; but the district was much frequented before by traders and trappers, whose effects are always transported by cattle, which subsist themselves throughout the year by grazing—a fact remarkably significant of the winter climate, and depth of snow which falls in the district, the general elevation of which may be safely taken at 7,000 feet above the sea. And it is said, by these people, to be a well-established fact, that horned cattle, of which their stock largely consists, cannot so subsist where the snow is deep enough to bury their eyes and enter their ears as they feed. I have already stated, in this report, that the Mormons have commenced a settlement near Fort Bridger, and that large herds of cattle were grazed near it during the early part of the winter, and were subsequently driven over the mountains, and remained in the valley of the Weber river until spring.

Two ranges of mountains, more or less united, intervene between this valley and that of Great Salt lake. The first, or more eastern, is the Bear River range, which is broken and surmounted by elevated peaks towards the north, but is more broad and open towards the south, where it unites with spurs of the Uinta and Wahsatch ranges. It is drained on the east by Black's fork and its tributaries, an affluent of Green river, and on the west by Bear river itself, which rises in the Uinta mountains and flows northward, breaking through the Wahsatch range and emptying into Great Salt lake.

The second, or western range, which stands immediately on the eastern border of the Basin, is the Wahsatch, extending from Little Salt lake, in a very direct line northward for 300 miles to Bear river. It is broken, towards the south, only by the passage of the Sevier river; but on our present line by the narrow passages of the Timpanogos and Weber rivers, by either of which, after crossing the first range, by ascending the divide between Black's fork and the Muddy, and crossing the heads of the latter stream and Bear river to the head of White Clay creek, (an affluent of the Weber) it is very practicable to descend to the valley of the Great Salt lake with a railroad. Looking westward, from the divide just indicated, the country presents a broad, level appearance, and it is difficult to realize its great elevation. It is, however, intersected by the valleys and ravines of the various water-courses by which it is drained, and which extend into the Porcupine terrace, lying at the northern foot of the Uinta mountains. The greatest elevation upon the line occurs upon this terrace, between the sources of Black's fork and the Muddy, and, as indicated by our barometers, is 8,373 feet above the sea. By ascending the Muddy, two hundred feet of this elevation would be avoided; but the line would require more and smaller curves. It is here, also, that the greatest depth of snow is encountered, and it increases in depth as we approach the snowy Uinta range. When we crossed it, in April, the streams were not swollen, and we could not discover that it had diminished by the warmth of the season from its usual winter depth. On the northeast slopes of the hills and ravines it had accumulated in deep drifts, but its general depth varied, for a few miles, from twelve to sixteen inches; and in crossing Bear river, and on the head of White Clay creek, it was from eight to twelve inches; but below this we encountered no snow. The timber of this section is limited in quantity, the ridges being dotted with a scattered growth of small cedar, and the Porcupine terrace dark with a respectable growth of spruce, pine, and fir. The soil of the mountains is superior, and covered with a luxuriant growth of grass. The distance from Smith's fork, on which we encamped, near Fort Bridger, by the line of the Timpanogos river, to the northern point of Oquirrh mountains, at the south end of the Great Salt lake, and on the western side of the valley of the Jordan, is 182.55 miles; and the same point would be reached by descending the Weber from the mouth of White Clay creek and following the eastern and southern shore of the lake, by a line of equal length. The respective average grades and altitudes upon these lines, and throughout the lines of the survey, will be found in the accompanying table and upon the profiles submitted with this report. There are large cañones on both of these streams—one upon the Timpanogos, and two upon the Weber. The former is ten miles in length. It is from 100 to 300 yards wide, and very direct in its general course; but projecting masses or spurs on either side of the river overlap partially, giving it a slightly sinuous course at the bottom. The great mass of the rock of which it is formed is blue limestone, on the south side often nearly vertical, but more inclined and open and covered with small stones and a luxuriant growth of vegetation on the north side, along which we rode. It will be necessary, in passing it with a railway, to bridge the river at several points to avoid curves, and to blast the rocks to a considerable extent at some points, amounting, however, to no large aggregate. The river is thirty yards wide, descending with a powerful current. The upper cañon on the Weber deserves the name only of a gorge or defile. It is eight and a half miles in length. The passage is more broad and open, and not so direct as that of the cañon twelve miles below, on the border of the valley of Great Salt lake. The mountains rise to a great height above it, and are rocky and precipitous, and much broken by ravines. The river winds from side to side, frequently striking against the base of the mountains, and the path crosses it frequently; and in constructing a railroad it will be necessary to bridge it several times. But it can be built by cutting and filling at the base of the mountains with the same facility that roads are carried elsewhere at mountain bases, where the formidable name of cañon is not encountered. The lower cañon, which is four miles long, in some parts wel deserves the name. It is, however, very direct, with an average width of 175 yards, the stream being 30 yards wide, and frequently impinging with great force against the base of the mountains. At a single point only, near the head of the cañon, the river is narrowed to one half its usual width, 30 yards, and has cut a passage 20 or 30 feet deep through the solid rock, which on the north side, at this point, overhangs the stream, which is deflected from its course by a low projecting mass, for a few yards, but again immediately resumes it. The rocks are principally gneiss. The mountains are sufficiently retreating to admit of a practicable passage of the gorge by a railway, and it will require an amount of blasting no greater than is required in constructing a road on a rocky mountain side of similar extent elsewhere. Entering the valley of Great Salt lake from either this or the Timpanogos cañon, a railway meets with no obstruction in passing by the south end of the lake and crossing the Jordan, Tuilla valley, and Spring or Lone Rock valley, to its west side, the grades being merely nominal.

The settlement and cultivation of this valley by the twenty-seven thousand industrious people who inhabit it—the number at which the church authorities estimated their population when I was among them, and it did not seem to be an exaggeration—is so obviously a matter of great importance in connection with the construction of a continental railway, that only the simple statement of its being embraced in this line is necessary, and that its construction is an object which the Mormons are anxious to assist in accomplishing. From the western shore of Great Salt lake to the valley of Humboldt river, the country consists alternately of mountains, in more or less isolated ranges, and open, level plains, rising gradually from the level of the lake on the east to the base of the Humboldt mountains on the west, or from 4,200 feet to 6,000 feet above the sea. Cedar mountain lies immediately on the southwestern shore of the lake, and gradually subsides towards the north, terminating in Strong's Knob. But to pass entirely around it would unnecessarily increase the length of the line, for it can be crossed, not only by the line followed by Frémont in 1845, at an elevation of 800 feet above the lake, but apparently at a much lower elevation, a few miles north of this point. Immediately west of this range there occurs a desert plain of mud, about seventy miles in width from east to west, by its longest line, which becomes narrowed to forty, and eventually entirely disappears as it extends southward—less than thirty of which is miry by this line—and it is firm in proportion to the distance from the lake. Two or three small isolated rocky ranges stand in it, but it appears otherwise to the eye, as level as a sheet of water. To the west this desert is succeeded by broken mountain ranges, one of which is terminated towards the south near Pilot Peak, affording the means of reaching and passing to the succeeding plain. To the south of this passage, however, an equally favorable passage exists to the north of Fish creek, connecting directly with passages to the west quite to the base of the Humboldt mountains; and this will doubtless be the preferable line, as it will enable us to cross the desert by a shorter line and a more firm path. The ascending grades upon this section will be merely those of the ascent of the successive plains. The Humboldt mountains are a narrow but elevated ridge, containing much snow during most of the year. The length of the pass by which they will be crossed is nine miles, about three of which are occupied by a narrow rocky ravine, above which the road should be carried on the sloping spurs of the mountains, on the western descent. The summit of the pass is five hundred feet above the extensive plain east of it, but considerably more above the valley of Humboldt river, which succeeds it to the west. This pass offers no serious obstacle to the passage of a railroad. Cedar only is found in these mountains, and in those to the east of it, sufficiently large for railroad ties; and although it will require transporting for long distances, it is believed to be sufficiently abundant for the construction of the road.

The open valley of Humboldt river immediately succeeds this section, and should be followed for about 180 miles. No other description is necessary of this direct and valuable passage across the Basin than that given in an extract from Colonel Frémont's Geographical Memoir addressed to the Senate, appended to the journal of the 22d of May, in the preceding part of this report.

The country to the south of this valley consists of an alternation of narrow mountains and valleys rapidly succeeding each other. The mountains have a general north and south course, but not unfrequently vary many degrees from that general direction, and, occasionally, cross chains are seen, closing the valleys to the north and south; but large spurs more frequently extend out from succeeding chains, and unite to form cross ranges, or overlap and obstruct the view. They are sharp, rocky, and inaccessible in many parts, but are low and easily passed in others. Their general elevation varies from 1,500 to 3,000 feet above the valleys, and but few of them retain snow upon their highest peaks during the summer. They are liberally supplied with springs and small streams, but the latter seldom extend far into the plains. At the time of melting snows they form many small ponds and lakes, but at others are absorbed by the soil near the bases of the mountains. Grass is found in abundance upon nearly every range, but timber is very scarce, a small scattered growth of cedar only being seen upon a few ranges. The valleys rarely extend uninterruptedly east and west, to a greater width than five or ten miles, but often have a large extent north and south. They are very irregular in form, frequently extending around the ends of mountains, or are united to succeeding valleys by level passages. They are much less fertile than the mountains, but generally support several varieties of artemisia, relieving them from the character of barrenness or desert. There are, however, many barren spots in each of these valleys, and the soil is seldom one half covered with vegetation, even for a few acres, while the great mass of it is merely sprinkled by the sombre artemisia foliage, presenting the aspect of a dreary waste, unrelieved by inviting shades, grassy plats, and floral beauties, and is nowhere suitable for settlements and cultivation. The accompanying profile of the line which we traversed in this part of the Basin, will serve to convey a general idea of its formation. From Humboldt river, there are three lines which may be followed to the foot of the Sierra Nevada. That by the Noble's Pass road, leaving the river a few miles to the east of where we returned to it, is the most direct, and is believed to be the best, as it avoids the principal range of mountains which we crossed on the line followed a few miles to the south of this, the two lines uniting on the shore of Mud lake. By the line followed, it is necessary to cross two ranges of the general character of the Basin mountains. The third line leads from the sink of the Humboldt to Pyramid lake without obstruction; but of the line passing thence by its shores to Honey Lake valley, little is known. It is 119 miles by the line followed from Humboldt river to the west shore of Mud lake, at the foot of Madelin Pass; but the northern line will diminish this distance at least one-fifth. The fertility of this section corresponds with that of the line south of Humboldt river. The northern route explored across the Sierra Nevada, to which I have given the name of Madelin Pass, ascends the eastern slope of the mountains from Mud lake through the valley of Smoky creek. In leaving the lake valley, the pass leads for three miles through a narrow gorge in an outlying range of the Sierra Nevada. The sides of this gorge are formed of coarse, crumbling metamorphic rocks, much broken by side ravines. They rise very abruptly to the height of from 50 to 200 feet above the stream on the south side, and to a much greater elevation on the north side, swelling up two miles back into the high mountain ridge. The course of the gorge is direct, and varies in width from 100 to 150 yards, and can be followed without difficulty by a railroad. Above the gorge the valley of the creek expands to the width of half a mile at first, and afterwards of a mile; but again becomes narrowed to a ravine seven miles from the gorge. This valley is enclosed on the south side, except at a single point broken by a creek followed by Noble's road, by a precipitous rocky wall, rising at once to the level of the terrace above, which extends back to the foot of a high peak standing immediately at the summit of the pass. On the north side the valley is enclosed for seven miles by retreating mountain spurs, upon which a road can easily ascend to the terrace, which, in its eastern portion, is but a mile in width, with sloping ridges rising above it. Above this, however, it expands to the width of ten or twelve miles, but again becomes narrow as it approaches the summit of the mountain, where the grassy ascent is but 200 yards wide, with rocky hills rising gently two or three hundred feet above it. The soil of the pass is light, and the surface thickly covered with stones. Its width, and the character of the hills gradually rising above it in all parts, afford the means of ascending it by a very uniform grade. The length of the ascent is 22.89 miles by the direct line which we followed, and the difference of elevation of the extreme points 1,172 feet—the altitude of the summit being 5,667 feet above the sea. The latitude of our camp at the western base of the high peak was 40° 48′ 46″. The pass leads around this elevated peak, and by a gentle descent for five miles enters upon the broad, level plain of the summit of the mountains, extending for forty miles to the west; its width, north and south, varying from ten miles to mere open passages of a few hundred yards. No water is discharged from this plain, which receives the waters of a few small streams and springs forming grassy ponds. The irregular spurs, ridges, and isolated buttes rise but a few hundred feet above it, and are sparsely covered with a growth of cedar to the east, but with heavy pine forests to the west. In leaving this plain to cross the low ridge enclosing it to the west, the line enters a ravine valley a quarter of a mile wide, smooth and gradually ascending for a mile. It then expands to the width of a mile, and is grassy and smooth, and still ascends gently; but it again becomes narrowed to a quarter of a mile, and rises more considerably for the last half mile to the summit. The ridges rise gently on either side of the ascent, and are finely rounded and grassy, and it will be easy, by winding on these spurs, to increase the length of the approach somewhat, and to equalize the ascent; and the summit can readily be cut so as to diminish the altitude to be overcome 100 or 120 feet. The elevation of this point is 500 feet above that of the preceding plain, and 5,736 feet above the sea, and is the highest point in the pass, from which the descent is directly upon the waters of the Sacramento river. This descent is at first rapid and the ravine narrow; but it soon widens, and a creek descends from it with a free current. Spurs of the mountains, separated by ravines, project into the valley of this creek, leaving a direct and free passage, however, of fifty or sixty yards in width in the narrowest parts, and frequently expanding to half a mile. The descent is grassy and heavily timbered. For some miles from the summit, it will be easy to carry a road on the hillsides, descending at pleasure; but lower down it will become more difficult on account of the curves required for passing the side ravines, but it is still practicable. For this purpose the northeast side is the most favorable; for, although it contains the largest number of ravines, it is free from cañones, while the opposite side is obstructed by a formidable one five miles below the summit, and a second three miles below this. The length of the descent to the broad open plain of Round valley, to which it leads, (on the Sacramento,) is fifteen miles, one half of which must be effected by following the mountain side. The total descent is 1,300 feet.

Round valley, through which the Sacramento river descends from the northeast, and through which a road can be carried at pleasure, extends for 15 miles below this point to the head of the first cañon of the Sacramento. This cañon is a formidable obstacle to be overcome. Its entire length is 13.74 miles, succeeded by an open valley of similar extent, which is followed by another cañon 8.95 miles in length, of the same character as the first. The river, as it enters the first cañon, is from 30 to 40 feet wide, flowing with a rapid current over a bed of rocks; and it is 60 feet wide as it enters the second cañon, just below the junction of Fall river, and flows over a similar bed with an equally swift current. At their heads these cañones are vertical trachytic rocks, 80 feet high, with large masses of fallen rocks accumulated at the bases of the walls. The first is cut through a high plain for six miles; the plain then rises somewhat, and is surmounted by high sloping ridges rising five or six hundred feet above it, and the cañon becomes much broader, and its walls more elevated for two miles, to where it makes a large bend to the north; below this the walls gradually decrease, and in two miles the cañon opens to the width of half a mile, which it preserves for three miles to the succeeding valley. The highest portions of the walls rise 200 feet above the stream, with an accumulation of fallen rocks extending half way to the top. For eight miles the course of the cañon is direct. It then makes a long bend to the north, and is followed by two or three short curves, but with a generally direct course. Its open part is timbered, and its walls less abrupt; and on the right bank of the stream, the mountains, followed by the river, extend considerably into the plain of Fall river. The most favorable line for the passage of a railway leads along the plain on the north side of the river, and descends the sides of the rocky hills which surmount it, and continues on the side of the mountain until it enters the plain of Fall river. The second cañon is only less formidable than the first because of its less extent. Its character is entirely the same, except that it is surmounted near its head by sloping mountain ridges of a similar altitude to the former. But on the south side, a few miles distant, the ridge subsides into rocky volcanic hills and plains. It will require a minute survey to determine the most practicable line by which to pass it; but it is probable that the best line will be found to leave the river a few miles above Fall river, and to pass around the ridge extending southward, and again return to the Sacramento at the mouth of Canoe creek, four miles below the foot of the cañon, avoiding short curves, which must be encountered in it, and diminishing the amount of rocky cutting; for in the passage of each of these cañones, the expense will be very heavy from this cause, and can only be estimated after an extensive and complete survey.

For 96 miles below the mouth of Canoe creek, to 17 miles above Fort Reading, the course of the Sacramento lies entirely through heavily timbered mountains, which rise precipitously from the river banks to the height of from 1,500 to 2,000 feet above the stream. Its course is winding, with all varieties of curves greater than a right angle, and it is seldom entirely straight for two miles consecutively, but its general courses are more uniform.

The foot of the mountains along the stream is often obstructed by fallen rocks to such an extent as to prevent its passage on horseback, and it is also obstructed by fallen timber and dense thickets of bushes; but the obstructions from fallen rocks are favorable rather than otherwise, for the construction of a railroad, as they will serve to form its sub-structure. At many points, but for short distances only, the way is obstructed by rocks in place. The road will require to be carried on the side of the mountains, a few feet above the stream at high water, throughout this entire section to the open valley of the Sacramento, whence it can be continued on the open plain. The latitude of our camp, near the northwest angle of the river, was 41° 03′.

The southern or Noble's pass of the Sierra Nevada (which I explored) branches from Madelin Pass, and the general line followed, on the western shore of Mud lake, which it follows to its southwestern termination, where it approaches nearest to Pyramid lake. It then turns more to the west, and follows, for nine miles, an open passage of a mile in width, leading from Mud Lake valley to that of Honey lake. This valley extends 40 miles to the west, and is 20 miles wide in its broadest part, north and south. On the south it is enclosed by a high unbroken mountain range, and on the north by the outlying ranges, more or less broken, of the Sierra Nevada. The lake is about 15 miles in length and 8 or 10 in width. Its water is bitter. The head of the valley to the west is very fertile, and a settlement has been commenced in it, and will doubtless be continued. It is situated upon Susan river, which descends through the broad mountain depression followed by Noble's road to the summit of the Sierra Nevada. For seven miles above the valley this stream descends through a deep rocky cañon, frequently with vertical walls towards its lower portion, but more or less fallen and open above. It is also much broken by side ravines, and spurs of mountain ridges occasionally extend to it. In leaving the valley, outside of this cañon, there is, at first, an abrupt terrace rise, followed by the road, which continues along the sides of the ridges to the right of the ascent by a much less gradual and uniform ascent than that of the stream.

Seven miles above the valley the cañon becomes an ordinary ravine, and disappears about five miles higher up, where the mountain becomes broad and undulating, with irregular ridges rising above the general level, but still continues to rise to the vicinity of Pine creek, whence it continues its rolling character to Black Butte creek. It is doubtless practicable to accomplish the ascent of the first section of this pass, either by following the river or by rising as soon as practicable above its rocky walls, and following its general course above its cañon. By following the river, it will be necessary to carry the road on a rocky ledge, but the grades will be comparatively easy. The ascent by the terrace line will require an approach commencing on the foot of the mountain north of the pass, and rising gradually to the top of the cañon walls; and above this will encounter broad ravines for 12 miles. From this point to Black Butte creek, 31 miles, the construction of the road will be easy. From Black Butte creek, there is still a heavy rise for 12 miles to the west side of Black Butte. For the first eight miles the line follows the valley of the creek, and the foot of the mountain enclosing it to the west, (for the course is southward.) It then passes to the south around a large field of lava rocks, and, on a return curve to the north, passes to the west of Black Butte, and is continued thence to the west side of Hat creek without a material change of level, and is continued thence on the side of the mountain spur, extending into Canoe creek valley, and separating Hat from Wolf creek, and crosses the latter nearly on a level with the former, and is continued, two miles, to the western summit of the range on the side of the range itself. The length of this section from Black Butte creek is 35 miles, and the highest point upon the pass is found on it a short distance west of the Black Butte, and is 6,275 feet above the sea. The descent from the western summit is by a broad, heavily timbered ridge, lying between Bear Creek valley on the north and deep rocky chasms on the south. Its length is forty miles, with a variable width of from one and a quarter to six miles. Its altitude at the summit is 6,074 feet above the sea, and more than 5,000 feet above the foot of the ridge. Its character and the difficulties of its descent will be best understood by a reference to the preceding journal for the 12th of July, and the table accompanying it. By the residents in the lumber district of the descent, we were informed that in the vicinity of their mills they had never seen the snow more than four or six inches deep at any time during the winter, and that it never remained upon the ground for more than a week at a time in sufficient quantities to enable them to use sleds in their vocation. About the 10th of last January, Dr. Wozencraft, of California, with a small party, ascended this pass to its summit on a tour of exploration. They found the snow on the entire route, as they certify in a note placed in my hands by Dr. Wozencraft, "to average six inches in depth, and nowhere reaching eight or ten inches in its average fall. But," they say, "we encountered one drift of snow on the eastern slope of the Sierra Nevada, in a ravine extending a mile, averaging two feet or two feet and a half in depth." The entire length of the pass from Roop's farm, at the head of Honey Lake valley on the east, to the foot-hills of the Sierra Nevada on the west, is 110 miles, and its termination is at the head of steamboat navigation, in a fertile and cultivated portion of the Sacramento valley, which extends unobstructed to the tide-waters of the Pacific.

Further surveys upon this route would doubtless develop important improvements at various points; and at two, at least—one from the shore of the lake near Stansbury's island, by Pilot Peak, to the pass in the Humboldt mountains; and the other in crossing from Humboldt river to Mud lake—would probably diminish the length of the line by 106 miles. The grades, also, are doubtless susceptible of material improvement by minute surveys with the spirit-level, by which the irregular atmospheric variations, which more or less affect barometric observations, will be entirely avoided. This method of determining levels with limited means, on so extensive a line, infested throughout by hostile savages, in the brief time allowed for these explorations, was not practicable, nor was it necessary; for the accuracy of the method employed is quite sufficient for the determination of the general profile of the route.

There is an abundance of good stone for bridges and building purposes at short intervals upon all parts of this line. Water is also found in abundance for railroad purposes throughout those portions of the Sierra Nevada, Wahsatch and Rocky mountains explored, and also at a few miles intervals in the Basin, where it usually occurs in springs at the bases of the mountains, and in small streams descending from the higher peaks and ridges to the adjacent plains. And a simple reference to the map of the route will exhibit an important feature in the fact, that in its remarkably direct course, for its great length, from the Missouri west to the Pacific, it follows the ascending and descending valleys of permanent rivers and their tributaries for more than two-thirds of its entire length, and that water is abundant on all the intermediate spaces—affording the means of irrigation to a large extent wherever the lands are suitable for it; and that they will doubtless be found so wherever the sage plains are luxuriant, may be inferred from the rich aromatic odor and resinous properties of that plant, and from the exceedingly nutritious character of the grass scattered through it. And it is a well known fact, that the Mormons produce some of their finest crops from reclaimed sage plains.

By reference to the map and accompanying table of latitudes, it will be seen that the route explored conforms throughout to a remarkably straight line, deviating, west from Fort Bridger, only at the Timpanogos cañon, if that line be preferred to the Weber, and on the northern portion of the Sacramento river; and then only by 3 minutes and 4 minutes, respectively, from the line of the 41st parallel of north latitude. The length of this route from the Missouri to the Black Hills may be safely estimated not to exceed 647 miles, the distance given by Captain Stansbury from Fort Leavenworth to Fort Laramie, (outward journey); and his distance from the Black Hills to Fort Bridger, 347 miles, is given from actual measurement. From Fort Bridger to Fort Reading, by the line of the accompanying profile, the distance is 1,011.71 miles, (which may hereafter be diminished by at least 106 miles, as before pointed out,) giving a total length for this line of 1,899.71 miles.

With much respect, I am, sir, your very obedient servant,

E. G. BECKWITH,
First Lieutenant, 3d Artillery.

CHAPTER VIII.

Tables of Distances, Grades, Altitudes, and Latitudes.

I.—Table of distances and of approximate average grades per mile upon the line explored for a railroad from Smith's Fork, near Fort Bridger, in the valley of Green river, Utah Territory, via the Madelin Pass, to Fort Reading, in the valley of the Sacramento river, California, 1854.

II.—Table of distances and of approximate average grades per mile upon the line explored for a railroad from Mud lake, via Noble's Pass, to Fort Reading.—July 4 to 26, 1854.

III.—Table of latitudes on the line of the forty-first parallel of north latitude, explored for the Pacific railway, 1854.

I.—*Table of distances and of approximate average grades per mile, upon the line explored for a railroad from Smith's Fork, near Fort Bridger, in the valley of Green river, Utah Territory, via the Madelin Pass, to Fort Reading, in the valley of the Sacramento river, California,* 1854.

Station.	Intermediate distances.	Total distances.	Average grades per mile.	Altitudes above the sea.	Remarks and dates.
			Feet.	*Feet.*	
Smith's Fork	....	....	....	7254.4	April 11 and 12.
Black's Fork	....	9.00	69.50	7880.3	April 10.
Divide between Black and Muddy creeks	2.25	21.25	40.30	8373.7	Do.
Divide of Muddy and Bear river	6.10	27.35	39.40	8133.3	Do.
Divide of Bear river and White Clay creek	12.90	40.25	49.80	7490.8	April 9.
White Clay creek	11.50	51.75	41.90	7009.0	April 17.
White Clay creek, camp 13	8.75	60.50	54.20	6534.4	Do.
White Clay creek, camp 4, east from Salt Lake	10.00	70.50	84.20	5692.1	April 7 and 8.
White Clay creek, camp 4	....	....	....	5692.1	
Dry creek, camp 3	....	16.50	16.50	5419.1	April 6.
Sheep Rock, Weber river	8.50	25.00	27.00	5189.5	Do.
Ben Simon's creek, camp 2	12.20	37.20	28.50	4842.1	April 5.
Weber river, below the mountains	7.80	45.00	53.60	4424.1	Do.
Weber river, camp 15	5.25	75.75	3.80	5671.9	April 19.
Weber river, Kamas prairie	12.00	87.75	54.00	6319.4	April 20.
Timpanogos river, Kamas prairie	8.70	96.45	8.80	6242.6	Do.
Timpanogos river	5.70	102.15	32.80	6055.5	April 21.
Timpanogos river, head of Round prairie	5.20	107.35	60.90	5738.8	Do.
Timpanogos river	5.00	112.35	44.40	5516.7	Do.
Timpanogos river, foot of Round prairie	0.70	113.05	32.70	5493.8	Do.
Timpanogos river, head of cañon	4.70	117.75	2.00	5484.3	Do.
Timpanogos river, in cañon	3.00	120.75	30.10	5394.1	Do.
Camp	8.00	128.75	39.70	5076.7	Do.
American Fork	14.20	142.95	19.80	5796.0	November 6, 1853.
Camp 2, west from Salt lake	39.60	182.55	3.50	4657.0	May 6, 1854.
Camp 3, west of Tuilla valley	20.59	203.14	8.10	4487.5	May 7 and 8.
Camp 4, opposite Stansbury's island	13.70	216.84	18.20	4238.0	May 8 and 9.
Camp 5, west side of Mt. creek, Spring or Lone Rock valley.	21.45	238.29	9.60	4444.3	May 9 and 10.
Dry creek	10.26	248.55	99.90	5469.5	May 10.
Entrance into Cedar Mt. Pass	1.54	250.09	38.20	5528.4	Do.
Camp 6, in pass	3.24	253.33	16.10	5580.5	May 10 and 11.
Summit of Cedar Mt. Pass	2.15	255.48	364.40	6364.0	May 11.
First descent of Cedar Mt. Pass	0.23	255.71	773.90	6186.0	Do.
Camp 7, west of Cedar Mt. Pass	1.30	257.01	470.00	5575.0	Do.
Foot of mountain	2.43	259.44	329.00	4775.5	May 12.
Camp 8, Granite mountain	17.33	276.77	0.50	4666.4	Do.
Fish creek	39.80	316.57	10.20	5073.2	May 15.
Camp 10, Fish creek	16.50	333.07	0.20	5076.5	Do.
Summit of mountain spur	14.13	347.20	76.30	6154.1	May 16.
Camp 11, in mountain pass	7.47	354.67	10.90	6073.1	May 16.
Ascent to divide of 1st and 2d creek of the pass	1.82	356.49	226.50	6485.4	May 17.
Ascent to divide between 1st and 2d creek of the pass	1.12	357.61	177.50	6684.2	Do.
Ascending 2d creek	1.25	358.86	26.20	6717.0	Do.

Table of Distances, Altitudes, and Grades—Continued.

Station.	Intermediate distances.	Total distances.	Average grades per mile.	Altitudes above the sea.	Remarks and dates.
			Feet.	*Feet.*	
Summit of pass	1.93	360.79	142.60	6992.2	May 17.
Camp 12, descending pass	1.42	362.21	311.20	6550.3	May 17 and 18.
Foot of mountain	8.38	370.59	61.60	6034.4	May 18.
Open valley, lake to the left	6.86	377.45	12.00	5952.4	Do.
Camp 13, Willow spring	3.22	380.67	28.90	5859.3	May 18 and 19.
Base of hill	3.30	383.97	79.40	6121.4	May 19.
Top of deep ravine	5.07	389.04	101.30	6635.2	Do.
Passing over a mountain spur	1.65	390.69	18.10	6665.1	Do.
On a spur of mountain	2.57	393.26	17.50	6710.1	Do.
On a spur of mountain	0.54	393.80	29.60	6726.1	Do.
Camp 14	2.92	396.72	192.10	6165.1	May 19 and 20.
Camp 15, Franklin river, on plain east of the Humboldt mountains.	21.52	418.24	7.50	6004.2	May 20 and 21.
Camp 16, Franklin river, extensive grass-fields	14.84	433.08	3.90	6061.4	May 21 and 22.
Crossing a mountain stream	7.65	440.73	58.20	6506.3	May 22.
Summit of pass in Humboldt Mt.	2.89	443.62	25.20	6579.1	Do.
On stream, western slope of pass	0.80	444.42	78.40	6516.4	Do.
Creek, valley of Humboldt river	8.36	452.78	89.20	5770.4	May 23.
Junction of main forks	35.00	487.78	30.60	4700.0	
Camp 33, east bank of Humboldt river	135.00	622.78	4.10	4140.9	June 8 and 9.
Crossing of Humboldt river, camp 34	6.80	629.58	0.90	4147.0	June 9 and 10.
Lassen's Meadows, California road, camp 35	3.51	633.09	1.50	4152.2	June 10 and 11.
Foot-hills above Humboldt river	9.64	642.73	16.30	4309.0	June 11.
In bed of dry creek	7.86	650.59	23.30	4492.0	Do.
In bed of dry creek	6.93	657.52	64.50	4938.7	Do.
Summit of pass	5.50	663.02	97.20	5473.2	June 12.
Descending from pass	10.55	673.57	87.20	4553.1	Do.
Junction of dry creeks	4.68	678.25	30.50	4410.5	Do.
Bed of dry creek	1.85	680.10	73.20	4275.0	Do.
In valley	2.55	682.65	1.30	4278.2	Do.
Dry creek	8.17	690.82	21.20	4451.5	June 13.
On stream, in cañon	1.95	692.77	67.60	4583.3	Do.
On summit	1.37	694.14	206.50	4866.2	Do.
Descending into valley	2.55	696.69	40.30	4763.4	Do.
Passing small hill in valley	7.04	703.73	44.40	5076.2	Do.
Passing small hill in valley	2.54	706.27	17.00	5033.0	Do.
Valley of Mud lake	11.75	718.02	76.50	4134.0	Do.
Point of Mountain, lake valley	15.39	733.41	00.00	4134.0	June 14.
East base of Sierra Nevada	9.88	743.29	1.60	4118.1	June 15 and 16, Camp 39.
Point of mount, shore of Mud lake	3.00	746.29	13.00	4079.0	June 16.
Foot of Madelin Pass, Smoky creek	16.00	762.29	18.20	4370.0	June 21.
Smoky creek, head of small cañon	3.00	765.29	41.70	4495.2	Do.
Smoky creek, ascending pass	3.00	768.29	61.40	4679.5	Do.
Smoky creek, ascending pass	2.50	770.79	59.10	4827.3	Do.
Smoky creek, ascending pass	2.50	773.29	74.90	5014.6	Do.
Ascent of the Sierra Nevada	3.56	776.85	8.60	5045.3	June 22.
In a broad valley, ascending pass	1.55	778.40	76.30	5163.5	Do.
In a broad valley ..... do	1.56	779.96	78.30	5285.6	Do.
In a broad valley ..... do	1.55	781.51	94.50	5432.1	Do.
In a broad valley	1.56	783.07	50.90	5511.5	June 22.
Ascent	1.32	784.39	100.00	5643.5	Do.
Summit of Madelin Pass	0.79	785.18	30.40	5667.5	Do.
On broad summit of Sierra Nevada	2.00	787.18	24.70	5620.0	Do.
On broad summit of Sierra Nevada	1.98	789.16	31.80	5557.0	Do.
On broad summit of Sierra Nevada	1.94	791.10	66.80	5427.5	Do.
Camp 45, broad plain, Sierra Nevada	3.85	794.95	46.00	5250.5	June 22 and 23.
Camp 47, broad plain, Sierra Nevada	21.90	816.85	0.50	5239.1	June 24 and 25.
Water-course	10.57	827.42	32.80	5585.5	June 25.
On divide in pass	1.63	829.05	92.30	5736.0	Do.
	1.63	829.05	18.70	5616.0	Deep Cut.
	2.42	831.47	124.10	5315.6	
Stream west of summit of the Sierra Nevada	2.42	831.47	173.70	5315.6	June 25.
Stream west of summit of the Sierra Nevada	1.73	833.20	62.50	5207.5	Do.
Base of hill, in valley	3.20	836.40	86.00	4932.2	Do.
Waters of the Sacramento river	3.67	840.07	125.40	4472.0	June 26.
East of stream, in Round valley	2.25	842.32	25.00	4415.7	Do.
Base of hill, in Round valley	2.08	844.40	10.00	4395.0	Do.
Leaving creek	1.25	845.65	76.60	4299.2	Do.
Camp 49, west side of stream	8.81	854.46	19.50	4127.4	Do.

Table of Distances, Altitudes, and Grades—Continued.

Station.	Intermediate distances.	Total distances.	Average grades per mile.	Altitudes above the sea.	Remarks and dates.
			Feet.	*Feet.*	
Foot of Round valley, head of first cañon of Sacramento river.	4.76	859.22	5.60	4153.9	June 27.
Foot of first cañon of Sacramento	13.74	872.96	38.70	3622.4	June 29.
Mouth of Fall river, and head of second cañon	13.50	886.46	27.60	3249.9	Do.
Sacramento river, mouth of second cañon	8.95	895.41	35.00	2937.0	July 21.
Mouth of Canoe creek	4.70	900.11	14.90	2867.2	Do.
Sacramento river	22.50	922.61	30.70	2177.2	July 20.
Sacramento river, Camp 5, ascending from Fort Reading.	7.50	930.11	59.60	1730.3	Do.
Sacramento river	26.50	956.61	21.70	1156.0	July 18.
Sacramento river, Camp 3	4.70	961.31	16.60	1078.1	July 17.
Sacramento river, Camp 2	10.50	971.81	11.80	954.2	Do.
Mouth of McCloud's river	5.25	977.06	6.10	922.0	July 16.
Sacramento river	11.75	988.81	7.20	837.5	Do.
Fort Reading	22 90	1011.71	7.10	674.7	July 12 to 15.

II.—*Table of distances and of approximate average grades per mile upon the line explored for a railroad from Mud lake, via Noble's Pass, to Fort Reading.—July* 4 *to* 26, 1854.

Station.	Intermediate distances.	Total distances.	Average grades per mile.	Altitudes above the sea.	Remarks and dates.
			Feet.	*Feet.*	
Camp 39, east base of the Sierra Nevada	....	....	....	4118.1	June 15 and 16.
Shore of Mud lake	3.00	3.00	13.00	4079.0	June 16.
Warm springs	42.00	45.00	3.60	4231.6	July 5.
Old shore-line	7.50	52.50	7.10	4285.2	Do.
Camp 55, shore of Honey lake	8.50	61.00	22.40	4094.6	July 4, 5, and 6.
Willow creek	11.36	72.36	1.30	4080.0	July 4.
Camp 54, Roop's rancho	8.64	81.00	11.70	4181.0	July 3.
Susan river	4.00	85.00	10.10	4221.4	July 8.
Susan river	4.00	89.00	105.50	4643.6	Do.
Susan river	4.50	93.50	59.10	4909.7	Do.
Divide of Susan and Summit creeks	7.25	100.75	75.10	5454.1	July 9.
Lake or pond	7.25	108.00	31.10	5679.4	Do.
Divide of Summit and Pine creeks	2.25	110.25	54.30	5801.6	Do.
Pine creek, prairie	5.00	115.25	27.70	5663.3	Do.
Plains of the Sierra Nevada	2.89	118.14	63.30	5480.5	Do.
Plains of the Sierra Nevada	1.84	119.98	19.50	5516.3	Do.
Thick pine woods	1.70	121.68	71.90	5394.1	Do.
Thick pine woods	2.05	123.73	64.90	5261.1	Do.
Camp 59, Black Butte creek	1.55	125.28	113.70	5084.8	July 9, 10, 23, 24.
Bed of dry creek	11.69	136.97	101.80	6275.4	July 10.
Near a pond	1.87	138.84	25.10	6223.4	Do.
Small creek and springs	1.53	140.37	19.00	6194.3	Do.
Canoe creek	3.75	144.12	5.80	6216.2	July 24.
West of Hat creek, side of mountain	2.75	146.87	45.10	6092.3	Do.
Spur dividing the valleys of Wolf and Hat creeks.	0.50	147.37	154.40	6015.1	Do.
Wolf creek	1.50	148.87	21.30	5983.1	Do.
Western summit of Sierra Nevada	2.00	150.87	45.50	6074.1	July 25.
Battle creek	5.00	155.87	49.80	5825.1	Do.
Battle creek	2.50	158.37	212.60	5293.6	July 11.
Western descent of Sierra Nevada	2.12	160.49	284.00	4691.5	Do.
Deer Flat, rancho	2.14	162.63	174.50	4318.1	Do.
Western slope of Sierra Nevada	1.69	164.32	101.70	4146.3	Do.
Hill's rancho, on Battle creek	2.00	166.32	7.30	4131.6	July 25.
Descending Sierra Nevada	4.14	170.46	47.60	3934.7	July 11.
Descending Sierra Nevada	3.58	174.04	136.60	3445.7	Do.
Camp 61, McCumber's mill	1.00	175.04	54.60	3491.1	July 12.
On stream	2.38	177.42	2.80	3497.8	Do.
Descent	3.05	180.47	230.10	2796.0	Do.
On stream	2.19	182.66	235.50	2280.2	Do.
Descent in valley	3.78	186.44	186.20	1576.4	Do.
Descent in valley	2.93	189.37	166.90	1087.4	Do.
On Dry creek	2.54	191.91	78.80	887.3	Do.
On Dry creek	4.37	196.28	41.40	706.5	Do.
Camp 62, Fort Reading	2.25	198.53	14.10	674.7	July 12, 13, 14, 15.

III.—Table of latitudes on the line of the forty-first parallel of north latitude, explored for the Pacific railway, 1854.

Sir: In the following table of geographical positions, the latitudes are all deduced from meridional observations, and, when practicable, both north and south culminating stars were observed, for the purpose of eliminating instrumental and other errors.

The astronomical instruments were the same as those used last year with Captain Gunnison, and pronounced by him entirely inadequate for the determination of longitude. They were, besides, very much out of repair and adjustment when we started from Westport—defects which could not be remedied in Salt Lake City.

Very respectfully,
SHEPPARD HOMANS,
In charge of Astronomical Department.

First Lieut. E. G. Beckwith,
U. S. A., Commanding Expedition.

Geographical positions from Green river, Utah Territory, to Fort Reading, California, via Salt Lake City.

Date.	Locality.	Star.	Double mer. alt.	Index error.	Corrected altitude.	Deduced latitude.	Latitude of camp.
1854.				′ ″			
April 15	Muddy creek	Alpha Hydra	81 12 30	15 12.5	40 42 29	....	41 15 43
16	Bear river	do.	81 28 45	15 47	40 50 54	....	41 07 18
17	White Clay creek	do.	81 47 30	16 22.5	41 00 34	....	40 57 38
19	Weber river	do.	81 57 30	....	41 05 34	....	40 52 38
1853.							
Dec. 6	Salt Lake City	Sun	52 49 00	1 37	26 39 51	....	40 45 37
1854.							
May 9	Lone Rock valley	Spica	78 12 40	10	39 05 13	....	40 30 46
12	Camp 8, Granite mountain	do	78 48 45	15	39 23 22	....	40 12 37
16	Camp 11	do	79 03 05	15	39 30 24	40 05 35	....
16	do.	Polaris	77 18 00	....	38 37 55	40 06 14	40 05 55
17	Camp 12	do.	77 14 20	5	38 36 10	40 04 29	....
17	do.	Spica	79 04 40	....	39 31 22	40 04 37	40 04 33
18	Willow spring	Polaris	77 34 00	....	38 45 59	40 14 18	....
18	do.	Spica	78 45 35	....	39 21 50	40 14 09	40 14 14
19	Camp 14	Polaris	77 50 45	12.5	38 54 18	40 22 37	....
19	do.	Spica	78 27 40	....	39 12 45	40 23 14	40 22 56
20	Franklin river	Polaris	78 15 10	15	39 06 23	40 34 43	....
20	do.	Spica	78 04 10	....	39 00 58	40 35 01	40 34 52
21	do.	Polaris	78 29 40	5	39 13 52	40 42 12	....
21	do	Spica	77 50 40	....	38 54 20	40 41 39	40 41 50
26	Camp 20	Polaris	78 05 10	2.5	39 01 37	40 29 58	....
26	do	Spica	78 14 35	....	39 06 20	40 29 39	40 29 49
27	Camp 21	Polaris	77 44 30	....	38 51 15	40 19 36	....
27	do.	Spica	78 35 15	....	39 16 39	40 19 20	40 19 28
30	Camp 24	Polaris	77 34 45	....	38 46 23	40 14 44	....
30	do.	Spica	78 44 30	....	39 21 14	40 14 44	40 14 44
31	Camp 25	Polaris	77 27 30	10	38 42 43	....	40 11 04
June 3	Camp 28	do.	77 32 10	....	38 45 01	....	40 13 23
4	Camp 29	Spica	78 38 30	12.5	39 18 14	....	40 17 45
7	Camp 32	Polaris	78 10 35	....	39 04 12	40 32 34	....
7	do.	Spica	78 11 35	....	39 04 52	40 31 07	40 31 51
10	Lassen's meadows	Beta Libra	80 58 35	....	40 28 21	....	40 42 03
16	Mud lake	do.	80 57 05	....	40 27 37	....	40 41 48
19	Madelin Pass	do.	80 52 10	....	40 25 13	....	40 44 12
20	do	do.	81 03 30	....	40 30 51	....	40 38 35
22	Camp 45	do.	80 43 10	....	40 20 39	....	40 48 46
23	Camp 46	do.	80 50 10	....	40 24 10	....	40 45 15
24	Camp 47	do.	80 40 20	....	40 19 12	....	40 50 14
25	Camp 48	do.	80 13 20	....	40 05 42	....	41 03 43
26	Camp 49	do.	80 11 10	....	40 04 36	....	41 04 49
27	Camp 50	do.	80 23 10	....	40 10 38	....	40 58 47
30	Camp 51	do.	80 37 10	....	40 17 39	....	40 51 46
July 1	Camp 52	do.	80 54 40	....	40 26 25	....	40 43 00
2	Summit creek	Antares	46 48 50	....	23 22 36	....	40 31 02
3	Roop's rancho	do.	47 01 50	....	23 28 52	....	40 24 46
4	Shore of Honey lake	do.	47 09 00	....	23 32 42	....	40 20 56
9	Black Butte creek	do.	46 33 40	....	23 15 00	....	40 38 38
10	Wolf creek	do.	46 40 50	....	23 18 35	....	40 35 03
15	Camp	do.	46 28 30	....	23 11 55	....	40 41 43
17	Sacramento river	do.	46 20 40	....	23 08 04	....	40 45 34
18	do.	do.	46 17 00	....	23 06 22	....	40 47 16
19	do.	do	45 47 00	....	22 51 17	....	41 02 21
20	do.	do.	45 45 40	....	22 50 38	....	41 03 00
21	Camp near mouth of Canoe creek	do.	45 58 30	....	22 57 03	....	40 56 35
26	Near Fort Reading	do.	46 51 40	....	23 23 36	....	40 30 02

CHAPTER IX.

Meteorological Observations, and Tables of Altitudes and Distances.

I.—Introduction to meteorological table and table of altitudes and distances, on the line of the forty-first parallel of north latitude, explored for the Pacific railway.

II.—Meteorological table at Great Salt Lake City during the winter of 1853–'54.

III.—Summary of meteorological observations at Great Salt Lake City in 1853 and 1854, in mean results at each observed hour for the several months; barometric reading corrected for temperature.

IV.—Barometric means for the months observed at Great Salt Lake City, 1853–'54, from all the observations, including those at irregular hours, and corrected in detail for horary variation of pressure.

V.—Meteorological observations and table of altitudes and distances from Great Salt Lake City to Green river, April, 1854.

VI.—Data for profile from Smith's fork, Green River valley, to that of Great Salt Lake, via the Timpanogos river.

VII.—Data for profile from Great Salt Lake valley, via the Weber river, to White Clay creek, the preceding profile being in common with this from the latter point eastward.

VIII.—Meteorological observations and table of distances from Great Salt Lake City, Utah Territory, to the valley of the Sacramento river, California, 1854.

IX.—Meteorological observations and table of altitudes from Mud lake, via Mud creek, to the summit of the Sierra Nevada and to Madelin Pass. (Table not used in profile.)

VIII.—Continuation of Table VIII.

X.—Meteorological observations and table of altitudes in crossing from Madelin to Noble's Pass, on the summit of the Sierra Nevada. (This table is not used in profile.)

VIII.—Table VIII again resumed.

XI.—Meteorological observations and table of altitudes and distances for profile from Mud lake to Fort Reading on the Sacramento river, California, via Noble's Pass.

XII.—Meteorological observations and table of altitudes on the road leading through Noble's Pass.

XIII.—Meteorological observations and table of altitudes in crossing from the mouth of Canoe creek (Poinsett river) to Black Butte creek, and thence west to Hat and Wolf creeks. (This table is not used in profile.)

I.—*Introduction to meteorological table and table of altitudes and distances on the line of the forty-first parallel of north latitude, explored for the Pacific railway.*

The Bunten barometers Nos. 496 and 551 are exclusively relied upon for the determination of altitudes of the entire line. The readings of the Aneroid barometers exhibit variable errors; and as the mercurial barometers retain their reliable and uniform character throughout, no necessity exists for the use of the Aneroids. The zero errors found by Dr. Engelmann in his comparison at St. Louis, to apply to the Bunten barometers before the commencement of the work, did not remain as between the two instruments, even at the first considerable camps of the survey; they were therefore rejected in all the computations, and no zero error was at any time applied. For mean readings the two barometers usually agreed very nearly, the difference between them being, that No. 496 was too slow in its movement when considerable changes of altitude occurred, and required a correction or substitution of the other in such cases. For mean readings at stations where several observations were taken, the results of both are believed to be a very near approximation to standard accuracy, and the instruments appear to have been but slightly, if at all deranged at the termination of the survey. The zero errors found in them by Dr. Engelmann, on their return, were obviously introduced after the close of the work, and are therefore not applied to it.

In the discussion of the observations, the readings were first corrected for temperature to the height of the mercurial column, at 32° Fahrenheit. A minor error of non-adaptation of the common formula to the temperature expansion determined by Shumacher for barometers of this construction is thus avoided, and the greater advantage gained of combining all the observations at a station in a correct mean reading, to be used in a single computation of the altitudes. The mean of the observed air temperature is used in these cases also, as avoiding to some extent a source of error in extremes of surface temperature, for which, in single observations, a table of corrections is appended. All the observations were also corrected for *horary variations* of atmospheric pressure through the day, thus bringing each to the true mean position for the day. The accompanying scale of horary corrections gives the value employed for each hour; they are derived primarily from well-determined curves of daily variations of pressure for the eastern United States, but with material and important modifications and additions established by the observations of other surveys in the interior of the continent, principally by that of Lieut. Whipple. By the observations through the winter months at Great Salt Lake City, the measures of this horary scale are shown to be less for that season, and to conform these more nearly than in summer to those observed in the eastern United States and in Europe. For the months occupied in the field-work of this survey, however, and for the districts traversed, the measure of the correction here employed is fully confirmed. At the sea-level, or so near it as both extremities of the line are, the measures of horary variation again fall off to those belonging to well known districts; yet as no determinations of importance occur at these extremities, it is not necessary to give the scale belonging to them. A correction previously found to be required for extremes of air temperature has been so well determined by the comparison of survey by levels and with the barometer, at the passes of the Sierra Nevada, surveyed by Lieut. Williamson, that a scale of corrections sufficiently precise for practical use has been constructed. When the error from this cause could not be eliminated by the use of mean temperatures, this scale has been employed in the determinations here made. The measures given for this correction belong to extremely arid climates, and to elevated districts, requiring modification in the position of the point where no correction is required; also in different seasons. As it affects great elevations in these arid districts by an extreme amount, of at least 150 feet, it is too important to be neglected, notwithstanding a discretionary use of the value is usually necessary.

The reduced observations at stations on the Plains, from Pawnee fork to camp 33, the first after crossing the Arkansas river, were referred to the mean barometric readings noted by Dr. Engelmann at St. Louis, for July, 1853, the month in which they were made.

The altitude of this station above the Gulf of Mexico, as determined by him from a long series of observations, was added to make up the entire altitude. For these stations and dates, the results thus obtained are very nearly identical with those computed by direct reference to the barometric mean at the level of the sea for the latitude.

For altitudes beyond this point, direct comparison of each camp is made to an assumed mean barometric reading at the level of the sea, in this latitude, of 30.000 inches, the barometer corrected to 32°, and a mean air temperature taken of 57°. The constant belonging to the latitude and climate of the Gulf is 30.050 inches of the barometer, and 64° of air temperature, which would add unduly to the altitudes.

The principle is assumed that the constants of pressure and temperature employed belong to the latitude, and that the resulting determinations of elevations belong, correctly and alike, to both the Gulf, the Atlantic and Pacific. There are no well-determined mean readings of the barometer on the Pacific coast, yet the most of those recently made in California give the impression that a slightly greater mean atmospheric pressure exists there than in the same latitude of the Atlantic. The constant has not, however, been altered for any portion of this line.

The discussion of observations at the principal passes has been, in part, upon simultaneous observations at an hour's interval in time and distance. The slower movement of one barometer, however, rendered it necessary in many cases to take successive readings of the best one, corrected for horary variation, for determinations of successive differences. The termini of these lines of ascent an descent were also checked by comparison of preferred results, as of the mean of several at the summit or elsewhere, with the nearer camps. The coincidence of results by single and successive steps has been so satisfactory as to warrant the conclusion that the grades and altitudes of these passes are quite accurately determined. The correct use of such data in the joining of intermediate with main lines, and in the correspondence of single observations with the mean of observations, is the surest test of barometric survey, and discrepancies cannot be wholly removed. The principal cause of these discrepancies is in the non-periodic variation of atmospheric pressure, for which no constant or correction can be given, except by reference to continued readings for a month or more at some station near. Mean results best eliminate this error, and they are therefore preferred in the order of their number, or of the number of days they cover. In the ascent of the Arkansas, the uniform grade of the stream permits the use of four or five successive camps as a near result, and two or three non-periodic variations are thus eliminated. Subsequently, to Great Salt lake, a less error from this cause is likely to occur, as this variation is least in August and September.

For the survey eastward from Great Salt lake to the valley of Green river, the field readings are compared with those of the same date by the other barometer at Great Salt Lake City: these may be regarded as nearly simultaneous, (though the hours were not always the same,) from the fact that the same days, and portions of the day, were compared. For the remainder of the line to California, no mode of correction of this error existed, except in the preference of the means embracing the greatest number of observations; yet the errors have probably no practical importance.

The observations generally sustain the checking and criticism which rank the results as a determinate survey, with a near approximation to absolute accuracy, and, as among themselves, sufficiently conclusive of grades and points of comparison.

Horary corrections of the barometer.

Hour.	Inches.	Hour.	Inches.
6 a. m.	+.007	3 p. m.	—.030
7 a. m.	+.020	4 p. m.	—.045
8 a. m.	+.030	5 p. m.	—.050
9 a. m.	+.040	6 p. m.	—.030
10 a. m.	+.050	7 p. m.	—.020
11 a. m.	+.055	8 p. m.	—.005
12 m.	+.025	9 p. m.	—.000
1 p. m.	+.005	10 p. m.	+.010
2 p. m.	—.015	11 p. m.	+.020

Scale of corrections for extreme air temperatures.

Low temperatures.	High temperatures.
At 35° add 25°	At 95° subtract 15°
At 40 add 23	At 93 subtract 13
At 45 add 21	At 90 subtract 11
At 47 add 20	At 88 subtract 10
At 50 add 18	At 85 subtract 8
At 53 add 15	At 83 subtract 7
At 55 add 13	At 80 subtract 5
At 57 add 10	At 78 subtract 3
At 60 add 5	At 75 subtract 2

NOTE.—The measures of this correction are variable to some extent with the season, and apply nearly to departures from the mean of the month in which observations are made. It is here given as required for summer months, in which most of the observations in field surveys have been taken.

CAPTAIN GUNNISON'S BAROMETERS COMPARED WITH THE STANDARD BAROMETERS OF DR. ENGELMANN.

St. Louis, *June* 4 to 9, 1853.

Ten observations were made.

Range of standard barometer in that period from 29″.505 to 29″.748. Range 0″.243.

Mean differences of standard and compared barometers.

Bunten, No. 551 = E + 0″.006. Bunten, No. 496 = E + 0″.080
Aneroid, No. 9889 = E — 0″.015. Aneroid, No. 9293 = E — 0″.025

Extreme differences of range of standard and compared barometers.

$$\left.\begin{array}{ll}\text{Bunten, No. } 551 & = E - 0''.021\\ \text{Do.} & = E + 0''.027\end{array}\right\} = 0''.048, \text{ range of difference.}$$

$$\left.\begin{array}{ll}\text{Bunten, No. } 496 & = E + 0''.046\\ \text{Do.} & = E + 0''.109\end{array}\right\} = 0''.063, \text{ range of difference.}$$

$$\left.\begin{array}{ll}\text{Aneroid, No. } 9889 & = E - 0''.055\\ \text{Do.} & = E + 0''.035\end{array}\right\} = 0''.090, \text{ range of difference.}$$

$$\left.\begin{array}{ll}\text{Aneroid, No. } 9293 & = E - 0''.005\\ \text{Do.} & = E - 0''.045\end{array}\right\} = 0''.040, \text{ range of difference.}$$

E. represents Engelmann's standard barometer.

Both Bunten barometers are very slow in their movements. B. No. 551 gives a very dull sound when the tube is reversed, indicating air in the tube. No. 496 gives a clear sound, and is probably free of air.

The station of Dr. Engelmann's barometer is above low-water mark of the Mississippi 106.5, and above the Gulf of Mexico 482 feet.

Bar. Engelmann was in June, 1853, equal to—

Bunten, No. 551 — 0″.006
Do. No. 496 — 0″.080

The Aneroids were both set to correspond exactly with bar. E.

After the voyage to California and back, bar. Engelmann was found in September, 1854, equal to—

Bunten, No. 551 — 0″.072
Do. No. 496 + 0″.116
Aneroid, No. 7889 — 0″.448
Do. No. 9293 + 0″.263

Therefore, as bar. E. has remained unaltered,

Bar. Bunten No. 551 is now higher by 0″.066 than 14 months ago.
Do. No. 496 is now lower by 0″.196 " "
Bar. Aneroid No. 7889 is now higher by 0″.448 " "
Do. No. 9293 is now lower by 0″.263 " "

Bunten No. 551 is by far the best instrument of the whole set; but both barometers have the sides of the tubes at the lower as well as the upper levels so much soiled and darkened by oxydized mercury, that at a certain elevation of the barometer, at least, the reading becomes very difficult, if not impossible.

The Aneroids are certainly very unreliable; but within the limited range of my observations, (between 29 and 30 inches,) they performed well and corresponded pretty accurately with the changes of my own barometer.

In calculating elevations from barometrical data, it seems best not to compare isolated observations made on the same day or at the same hour, but to refer the observations made in the field (or the mean of several if they can be had) to the monthly means of the stationary barometer. I add, therefore, my monthly means for the last fourteen months. But the observations made west of the Rocky mountains cannot be referred to my barometer at all. It is hardly necessary to add—what everybody who is in the habit of observing the barometer knows—that observations made in the forenoon, principally from 8 to 10 o'clock a. m., are generally higher, and those made in the afternoon, principally between 2 and 4 o'clock, are mostly lower than the average of the day. The noon observations come nearest the mean of the day. The barometer, at least in the Mississippi valley, is usually highest with westerly and northwesterly winds, and lowest with southerly and southeasterly winds. It is mostly higher, but much more irregular, in winter, and lower, but more regular, in summer.

Mean barometric elevation of barometer E. at St. Louis, 482 feet above the Gulf.

Table of means corrected for temperature.

June,	1853	29.466
July,	1853	29.483
August	1853	29.431
September,	1853	29.474
October,	1853	29.538
November,	1853	29.601
December,	1853	29.508
January,	1854	29.577
February,	1854	29.507
March,	1854	29.459
April,	1854	29.444
May,	1854	29.334
June,	1854	29.418
July,	1854	29.491

G. ENGELMANN.

ST. LOUIS, *September,* 1854.

The discrepancy found to exist by Dr. Engelmann in the Bunten barometers after our return from California did not exist as between themselves up to the termination of the exploration in July, and must have arisen from some cause on our homeward journey, and is disregarded, therefore, in the discussion.

Horary variations of the barometer in California.

1. In the elevated portions of the interior.

Hour.	Inch.	Hour.	Inch.
5 a. m.	—.007	2 p. m.	—.025.
5 a. m.	—.005	3 p. m.	—.030
6 a. m.	+.012	4 p. m.	—.035
7 a. m.	+.025	5 p. m.	—.033
8 a. m.	+.030	6 p. m.	—.025
9 a. m.	+.035	7 p. m.	—.015
10 a. m.	+.040	8 p. m.	—.005
11 a. m.	+.045	9 p. m.	+.008
12 m.	+.015	10 p. m.	+.015
1 p. m.	—.005	11 p. m.	+.013

2. At the sea-level, or near the coast.

Hour.	Inch.	Hour.	Inch.
4 a. m.	—.007	2 p. m.	—.025
5 a. m.	—.005	3 p. m.	— 030
6 a. m.	+.012	4 p. m.	—.035
7 a. m.	+.02	5 p. m.	—.033
8 a. m.	+.03	6 p. m.	—.025
9 a. m.	+.041	7 p. m.	—.015
10 a. m.	+.045	8 p. m.	—.005
11 a. m.	+.035	9 p. m.	+.008
12 m.	+.015	10 p. m.	+.015
1 p. m.	—.005	11 p. m.	+.013

II.—*Meteorological Observations at Great Salt Lake City*, 1853–'54.

Locality.	Date.	Hour.	Barometer, No. 496.	Attached thermometer, (C.)	Barometer, No. 551.	Attached thermometer, (C.)	Corrected barometer, No. 496.	Corrected barometer, No. 551.	Air temperature, (F.)	Remarks.
	1853.						*Inches.*	*Inches.*		
Great Salt Lake City, at the house of Mr. Benson, opposite the Council-house and Tithing-office.	Nov. 29	10 a. m.	657	10.5	655.5	11	25.773	25.710	49	Rain in valley; snow in mountains; cool and unpleasant.
	29	12 m.	655.4	10	654.3	10	25.735	25.692	50	Rain ceased to fall, but it still continues cloudy.
	30	9.30 a. m.	657.6	9.5	657.6	10	25.802	25.802	47	A few light clouds.
	30	12 m	657.9	12	658.5	12	25.822	25.849	51	Clear and pleasant.
	30	3 p. m.	657.9	13	658.5	14	25.873	25.897	53	Clear and pleasant, with a slight breeze from the southeast.
	Dec. 1	9 a. m.	658	10	658.3	10.5	25.823	25.834	46	Clear and pleasant.
	1	12 m.	658	13.5	658.3	14	25.826	25.834	53	A few light clouds in the northwest.
	1	3 p. m	658	15.5	658.3	16	25.873	25.881	57	Clear.
	2	9 a. m.	656.8	10.5	656.3	10.5	25.772	25.756	45	Clear; thermometer at sunrise 34°.
	2	12 m.	657.7	13.5	656.5	14	25.810	25.763	52	Light clouds.
	2	3 p. m.	656.5	14	655.1	14.5	25.818	25.763	55	Do.
	3	9 a. m.	656.5	11.5	655.1	12	25.756	25.701	48	Thermometer at sunrise 32°.
	3	12 m.	656.5	13	655.2	13	25.767	25.716	53	Clear.
	3	3 p. m.	656.5	13	655.2	13	25.822	25.771	54	Do.
	4	9 a. m.	655.8	10	.9	10	25.736	25.661	44	Thermometer at sunrise 31°.
	5	9 a. m.		9	654.9	9.5	25.712	25.701	43	Do do. 30°.5
	5	12 m.	655.7	12	655.6	12.5	25.739	25.731	50	Morning clear and cool.
	5	3 p. m.	655.7	13.5	655.6	13.5	25.786	25.786	53	Clear and pleasant.
	6	9 a. m.	659.4	9.5	658.9	9.5	25.878	25.858	43	Thermometer at sunrise 30°.
	6	12 m.	659.6	12	659.2	11.5	25.893	25.881	51	Clear and pleasant.
	6	3 p. m.	659.6	14	659.2	14.5	25.936	25.920	54	Clear.
	7	9 a. m.	659.8	9	659.6	9	25.897	25.890	41	Thermometer at sunrise 28°.
	7	12 m.	659.8	12	659.6	12	25.897	25.893	51	Clear.
	7	3 p. m.	659.8	13	659.8	13.5	25.948	25.948	52	Clear and pleasant.
	8	9 a. m.	659	8	657.7	8	25.874	25.819	40	Thermometer at sunrise 28°.
	8	12 m.	657.8	11.5	655.6	11.5	25.822	25.735	47	Morning clear and cool, with heavy frost.
	8	3 p. m.	656.3	13.5	655	14	25.810	25.759	54	Clear.
	9	9 a. m.	650.7	5	651.1	5	25.555	25.574	34	Thermometer at sunrise 26°.
	9	12 m.	650.7	7	651.1	7	25.562	25.582	35	Heavy mist, with a cold northwest wind.
	9	p. m.	648.8	8	650	8.5	25.538	25.589	37	Cloudy.
	10	9 a. m.	647	6	648.5	6	25.409	25.464	38	Thermometer at sunrise 28°; cloudy.
	10	12 m.	647	6	648.5	6	25.424	25.479	45	Cloudy; strong wind from northwest in the evening; rain.
	11	9 a. m.	647.5	8.5	649.7	8	25.417	25.504	41	Cloudy.
	11	11 a. m.	648.6	9	650.2	9.5	25.441	25.504	45	Do.
	12	9 a. m.	652.6	8	652.2	8	25.618	25.602	37	Hazy and cloudy.
	12	12 m.	652.3	8	652	8	25.621	25.713	39	Hazy.
	12	3 p. m.	652	7.5	650.7	7.5	25.768	25.613	39	Cloudy.
	13	9 a. m.	647.1	7	648.4	7	25.409	25.456	39	Thermometer at sunrise 36°; cloudy.
	13	12 m.	646	8	647.3	8.5	25.377	25.424	46	Cloudy and disagreeable.
	13	3 p. m.	645.2	8	647.3	8.5	25.401	25.479	48	Cloudy, with indications of rain.
	14	9 a. m.	644.7	7	647	7	25.315	25.405	42	Thermometer at sunrise 40°; slight fall of snow.
	14	12 m.	645	7	647.7	7	25.342	25.444	38	Cloudy and damp.
	14	3 p. m.	645	7	647.7	7	25.397	25.499	41	Damp; snow in mountains.
	15	9 a. m.	646.3	6.5	648.9	6.5	25.378	25.476	37	Thermometer at sunrise 33°.
	16	9 a. m.	652.3	5	651.9	5	25.618	25.602	30	Thermometer at sunrise 26°; clear.
	16	12 m.	653.1	6	653	6	25.664	25.660	37	Cloudy.
	16	3 p. m.	653.1	6	653	6	25.719	25.715	37	Do.
	17	9 a. m.	653.7	5	653.9	5	25.673	25.681	34	Thermometer at sunrise 33°; cloudy.
	18	9 a. m.	654.2	6.5	654.1	6.5	25.689	25.685	36	Thermometer at sunrise 30°; cloudy.
	19	9 a. m.	652.2	5	651.2	5	25.614	25.578	31	Thermometer at sunrise 26°; clear.
	19	3 p. m.	654.3	7.5	655.3	7.5	25.759	25.806	39	Cloudy.
	20	9 a. m.	648.1	6	648.7	6	25.452	25.472	39	Thermometer at sunrise 35°; cloudy.
	20	12 m.	648.7	6	648.7	6	25.487	25.487	43	Cloudy.
	20	3 p. m.	648.3	7	648.7	7.5	25.522	25.534	42	Cloudy; snow fell during the night to depth of four inches.
	21	9 a. m.	648.7	7.5	648.5	7.5	25.468	25.460	37	Thermometer at sunrise 34°; snow falling very fast.
	21	12 m.	648.7	7.5	648.5	7.5	25.483	25.475	42	Snow.
	21	3 p. m.	648	6.5	648	6.5	25.515	25.515	37	Do.
	22	9 a. m.	651.3	6.5	651.8	6.5	25.574	25.590	25	Thermometer at sunrise 24°; clear.
	22	12 m.	651.6	8.5	652.8	8.5	25.593	25.637	31	Clear.
	23	9 a. m.	652.3	5	653.6	5	25.618	25.669	22	Thermometer at sunrise 16°; clear.
	23	3 p. m.	652.2	10	651.2	10	25.664	25.625	32	Clear.
	24	9.45 a. m.	651.6	4	650.3	4	25.587	25.540	30	Clear and cool.
	24	12 m	650.6	6	649.5	6	25.562	25.519	36	Thermometer at sunrise 20°; cloudy.
	26	9 a. m.	652.7	5	652.3	5	25.634	25.618	27	A few light clouds.
	26	12 m.	652.6	6	652.3	6	25.641	25.629	37	Thermometer as sunrise 23°; cloudy.
	27	9.30 a. m.	653.5	6	653.1	6	25.656	25.644	38	Cloudy.

II.—*Meteorological Observations at Great Salt Lake City*—Continued.

Locality.	Date.	Hour.	Barometer, No. 496.	Attached thermometer, (C.)	Barometer, No. 551.	Attached thermometer, (C.)	Corrected barometer, No. 496.	Corrected barometer, No. 551.	Air temperature, (F.)	Remarks.
							Inches.	*Inches.*		
Great Salt Lake City..	1853. Dec. 27	12 m	653.5	8.5	653.1	8.5	25.664	25.653	44	Thermometer at sunrise 35°; cloudy.
	27	3 p. m.......	653.7	9	653.3	9	25.727	25.712	43	Cloudy.
	28	12 m........	653	11	650	11	25.637	25.523	46	Do.
	28	3 p. m.......	650.6	10	648.7	10	25.601	25.526	49	Clear and pleasant.
	29	9 a. m.......	650.2	7.5	650	7.5	25.527	25.519	35	Cloudy; snow fell during the night to depth of three inches.
	29	12 m........	650.2	8	650	8	25.538	25.534	35	Cloudy; strong wind from northwest.
	29	3 p. m.......	650.2	5.5	650	5.5	25.605	25.597	34	Cloudy; northwest wind.
	30	9.30 a. m....	656.3	4.5	656.2	4.5	25.774	25.770	24	Cloudy; slight fall of snow.
	31	9 a. m.......	659.8	5.5	659.8	5.5	25.909	25.909	25	Clear; thermometer at sunrise 18°.
	31	12 m	659.8	8	659.8	8	25.916	25.916	33	Clear.
	1854. Jan. 2	9.30 a. m....	659	5.5	657.3	5·5	25.877	25.810	28	Clear; thermometer at sunrise 22°.
	2	12 m	659.3	9	657.7	9	25.893	25.830	34	Clear.
	3	9.30 a. m....	653.2	9	651.1	9	25.633	25.550	42	Cloudy.
	3	3.30 p. m....	651.3	12	648.7	12	25.628	25.526	47	Do.
	4	9 30 a. m....	647.1	9	646.3	9	25.396	25.365	35	Thermometer at sunrise 32°; light clouds.
	4	12 m	647.1	9	646.1	9	25.416	25.377	37	Cloudy.
	4	3.30 p. m.. .	647.1	8.5	646.2	8.5	25.478	25.443	37	Do.
	5	10 a. m......	654.2	4.5	650.7	4.5	25.687	25.549	17	Thermometer at sunrise 14°; light clouds.
	5	12 m	650.2	4.5	650.6	4.5	25.554	25.570	21	Cloudy.
	5	3.30 p. m....	650.9	5.5	651.5	5.5	25.636	25.663	22	Light clouds; storm of northwest wind.
	6	9.30 a. m....	656.8	2	656.4	2	25.802	25.790	14	Thermometer at sunrise 8°; clear.
	6	12 m	656.8	2	656.4	2	25.822	25.810	18	Clear; strong wind from northwest.
	6	3 p. m........	658.3	4.5	658.9	4.5	25.928	25.948	19	Clear.
	7	9.30 a. m....	658.8	1	661.4	1	25.885	25.987	18	Thermometer at sunrise 12°; clear.
	7	12 m	658.8	4	661.4	4	25.893	25.995	27	Clear.
	7	3.30 p. m....	659.6	4	660.4	4	25.986	26.018	28	Do.
	9	9 a. m.......	655.6	4.5	654.3	4.5	25.752	25.701	28	Thermometer at sunrise 25°; snow fell during night, depth three inches.
	10	10 a. m......	655.3	7	655.1	7	25.718	25.714	30	Cloudy, with signs of snow.
	10	12 m	655.6	8	655.2	8	25.751	25.735	35	Clear.
	10	3.30 p. m....	656.1	12	657.1	12	25.817	25.856	34	Light clouds.
	11	9.30 a. m....	652.8	4.5	652	4.5	25.633	25.605	33	Thermometer at sunrise 25°; cloudy, with signs of snow.
	11	1.15 p. m....	651.7	6.5	649.8	6.5	25.626	25.552	34	Light fall of snow.
	12	9.15 a. m....	643.8	5	642.2	5	25.285	25.222	37	Thermometer at sunrise 36°; snow falling very fast.
	12	12 m	643.9	5	642.4	5	25.306	25.247	36	Strong wind from northwest.
	12	3 p. m	643.9	5	642.4	5	25.361	25.302	35	Snow still continues to fall.
	13	9.30 a. m....	643.1	8.5	641.5	8.5	25.243	25.176	44	Cloudy; thermometer at sunrise 34°.
	13	3 p. m.......	639.9	10	638.2	10	25.184	25.117	48	Cloudy; strong wind from northwest.
	14	9 a. m.......	637.2	9	637	9	25.012	25.004	45	Thermometer at sunrise 45°; lowering clouds; strong wind from southwest.
	14	12.45 p. m...	624	11	635.7	11	24.922	24.965	40	Hail storm; wind from northwest.
	14	3.30 p. m....	635.6	10	636.4	10	25.022	25.053	31	Snow falling very fast.
	15	9 a. m.......	639.5	6	639.4	4	25.114	25.118	28	Thermometer at sunrise 22°; cloudy; snow eight to ten inches deep.
	15	12 m	640.3	8	641	8	25.152	25.180	31	Cloudy.
	16	9 a. m.......	643.2	3	643.2	3	25.271	25.271	20	Thermometer at sunrise 19°; light clouds.
	16	12.20 p. m...	643.3	5	643.8	5	25.288	25.307	26	Light clouds.
	16	3 p. m.......	642.9	5	643.2	5	25.322	25.334	26	Cloudy; slight fall of snow during the night.
	17	9.15 a. m....	643.4	1	643.8	1	25.285	25.301	26	Thermometer at sunrise 24°; cloudy.
	17	12 m	643.2	4	642.4	4	25.283	25.251	34	Cloudy; slight fall of snow during the night.
	18	9.15 a. m....	647.2	1	647.7	1	25.435	25.450	16	Thermometer at sunrise 12°.
	18	12.30 p m...	645.8	1.5	645	1.5	25.403	25.371	29	Cloudy.
	18	3 p. m.......	644.7	5	643.2	5	25.393	25.334	24	Do.
	19	9.15 a. m....	636.7	— 1	637.4	— 1	25.029	25.057	19	Thermometer at sunrise 19°; snow falling very fast; wind northwest.
	19	12.25 p. m...	636.8	0	637.4	0	25.056	25.080	15	Snow ceased to fall; strong wind from northwest.
	19	3.30 p. m....	639.1	1	639.4	1	25.195	25.207	13	Cloudy, with signs of snow.
	20	9 a. m.......	653.3	— 6	654.6	— 6	25.708	25.760	0	Thermometer at sunrise 2°; cloudy.
	20	12.25 p. m...	654.9	— 1	656.7	— 1	25.777	25.848	0	Light clouds in northwest.
	20	3 p. m.......	655.6	0	656.8	0	25.842	25.849	0	Clear.
	21	9.30 a. m....	654.9	— 7	654.9	— 7	25.770	25.770	— 4	Thermometer at sunrise — 14°; light clouds in northwest.

II.—*Meteorological Observations at Great Salt Lake City*—Continued.

Locality.	Date.	Hour.	Barometer, No. 496.	Attached thermometer, (C.)	Barometer, No. 551.	Attached thermometer, (C.)	Corrected barometer, No. 496.	Corrected barometer, No. 551.	Air temperature, (F.)	Remarks.
	1854.						*Inches.*	*Inches.*		
Great Salt Lake City..	Jan. 21	12 m	654.9	— 3	653.6	— 3	25.775	25.723	5	Clear; wind from northwest.
	21	3 p. m.......	653.6	— 3	652.2	— 3	25.778	25.719	8	Light clouds.
	22	9.45 a. m....	658.6	— 2	658.5	— 2	25.881	25.890	8	Thermometer at sunrise 11°; clear.
	22	3 p. m.......	659.2	....	660.1	....	25.983	26.019	12	Clear.
	23	9.15 a. m....	658.1	— 3	657.8	— 3	25.880	25.872	16	Thermometer at sunrise 8°; light clouds in northeast.
	23	12 m	658.4	3	657.3	3	25.881	25.842	27	Light clouds.
	23	3.30 p. m....	657.9	3	656.2	— 3	25.923	25.884	21	Cloudy.
	24	9 a. m.......	651.7	— 1	651.5	— 1	25.665	25.736	26	Thermometer at sunrise 18°; cloudy.
	24	12.20 p. m...	649.9	— 0.5	648.7	— 0.5	25.591	25.543	27	Cloudy, with signs of snow.
	25	9.30 a. m....	646.2	3.5	648	3.5	25.381	25.451	39	Thermometer at sunrise 37°; snow fell during the night.
	25	12 m	646.2	3.5	645	3.5	25.401	25.353	38	Snow falling.
	25	3.30 p. m....	647.1	3.5	648.3	3.5	25.498	25.545	33	Cloudy.
	26	9.30 a. m....	655.9	3	656.4	3	25.763	25.782	14	Thermometer at sunrise 11°; clear.
	26	12.15 p. m...	657.2	5.5	657.3	5.5	25.831	25.835	28	Clear.
	27	10 a. m......	660.7	3	660.5	3	25.947	25.939	22	Thermometer at sunrise 6°; clear.
	27	12 m	660.7	5	660.5	5	25.964	25.956	30	Clear.
	28	9.15 a. m....	660.6	3	659.7	3	25.951	25.915	36	Cloudy, with signs of snow.
	28	12 m	660.7	7	659.8	7	25.956	25 920	37	Clear.
	29	9 a. m.......	660.7	5.5	659.4	5.5	25.945	25.897	37	Cloudy, with signs of snow.
	31	9 a. m.......	659.6	3	658.4	3	25.913	25.866	24	Heavy fog; thermometer at sunrise 15°.
	Feb. 1	9 a. m.......	644.9	3	647.7	3	25.338	25.445	24	Frost; thermometer at sunrise 18°; cloudy.
	1	12 m	646.9	2	647.7	2	25.357	25.464	31	Cloudy.
	2	9 a. m.......	655.3	2.5	654.9	2.5	25.738	25.728	18	Clear; thermometer at sunrise 14°.
	2	12 m	655.8	5	655.8	5	25.771	25.771	28	Clear.
	2	4 p. m.......	655.6	6	655.6	6	25.829	25.829	26	Do.
	3	9 a. m.......	654.3	2.5	653.2	2.5	25.708	25.665	27	Cloudy; thermometer at sunrise 18°.
	3	12.25 p. m...	654.7	6.5	653.8	6.5	25.730	25.694	34	Clear.
	4	9 a. m.......	653.8	5	652.8	5	25.677	25.638	38	Cloudy; thermometer at sunrise 28°.
	5	10 a. m......	653.9	6.5	653.5	6.5	25.663	25.651	44	Cloudy.
	5	3 p. m.......	653.2	7.5	650.7	7.5	25.715	25.673	38	Cloudy; at 12 m. slight fall of rain.
	6	9 a. m.......	652.7	8.5	651.8	8.5	25.622	25.582	40	Clear in northwest; sky partially overcast.
	6	11 a. m......	653.1	8	652.5	8	25.623	25.599	50	Cloudy.
	6	3 p. m.......	653.1	8	652.5	8	25.708	25.684	44	Do.
	7	9 a. m.......	653.2	7	652.3	7	25.645	25.610	40	Foggy.
	7	1 p. m.......	653.3	7.5	652.6	7.5	25.684	25.653	45	Cloudy, with signs of rain.
	8	9 a. m.......	654.6	6	655	6	25.705	25.724	34	Clear.
	8	12 m........	654.6	10.5	655	10.5	25.700	25.720	47	Do.
	9	9 a. m.......	652.6	7	651.9	7	25.622	25.594	35	Do.
	9	12.30 p. m...	652.8	10	651.8	10	25.643	25.603	48	Do.
	10	9 a. m.......	647.9	8	647.1	8	25.433	25.405	46	Cloudy; light breeze from southeast.
	10	12.15 p. m...	646.8	8.5	645.9	8.5	25.410	25.374	50	Cloudy; light breeze from southeast.
	10	3 p. m.......	646.5	8.5	645.7	8.5	25.448	25.416	46	Slight fall of rain.
	11	9 a. m.......	643	8	641.9	8	25.244	25.201	44	Stormy.
	11	12.30 p. m...	642.1	9	640.4	9	25.230	25.162	49	2.15 p. m. hail, with strong wind from southwest; 3 p. m. snow.
	11	3 p. m	642	9	640.3	9	25.271	25.204	37	Snow.
	12	9 a. m.......	643	5.5	644.2	5.5	25.275	25.299	34	Cloudy; light breeze from northwest.
	12	12 m........	643.4	5.5	643.3	5.5	25.282	25.279	35	Snow, falling very fast.
	12	3 p. m.......	643.4	5.5	643.3	5.5	25.338	25.334	32	Cloudy.
	13	9 a. m.......	643.1	2	643.3	2	25.271	25.279	28	Snowing very fast; strong wind from northwest.
	13	12 m........	645	4	645.2	4	25.353	25.361	32	Cloudy; snow ceased.
	13	3 p. m.......	646.5	7	647	7	25.456	25.475	35	Broken clouds; strong wind from northwest.
	14	9 a. m.......	652.2	2	652.2	2	25.630	25.630	25	Cloudy, with signs of snow; thermometer at sunrise 16°.
	14	12 m........	652.3	4.5	652.4	5	25.637	25.637	40	Slight fall of snow.
	15	9 a. m.......	653.2	4	652.1	4	25.661	25.618	29	Cloudy; thermometer at sunrise 20°.
	15	12 m...	653.2	3	652.1	3	25.680	25.637	44	Cloudy.
	15	3 p. m.......	653	3	652.1	3	25.727	25.692	38	Slight fall of snow.
	16	9 a. m.......	650.1	2.5	649.6	2.5	25.543	25.523	38	Thermometer at sunrise 32°; cloudy.
	16	12 m........	650.1	5	649.6	5	25.550	25.527	44	Few light clouds visible.
	16	3 p. m.......	650.2	5	649.8	5	25.609	25.589	40	Cloudy in the north and west.
	17	9 a. m.......	649.9	4	650	4	25.527	25.535	33	Clear; thermometer at sunrise 28°.
	17	12 m........	650.4	8	650.2	8	25.546	25.538	40	Clear; snow melting rapidly.
	17	3 p m.......	650.4	10	650.2	10	25.593	25.586	40	Clear.
	18	Sunrise	649.8	3	650.1	3	25.547	25.563	24	Clear and calm.
	18	10 a. m......	650.1	7.5	650.5	7.5	25.513	25.529	38	Clear and pleasant.
	18	12 m........	650.1	7.5	650.5	7.5	25.538	25.554	36	Clear, with light breezes from the north.

II.—*Meteorological Observations at Great Salt Lake City*—Continued.

Locality.	Date.	Hour.	Barometer, No. 496.	Attached thermometer, (C.)	Barometer, No. 551.	Attached thermometer, (C.)	Corrected barometer, No. 496.	Corrected barometer No. 551.	Air temperature, (F.)	Remarks.
	1854.						*Inches.*	*Inches.*		
Great Salt Lake City..	Feb. 18	3 p. m.......	650.5	10	650.6	10	25.597	25.601	35	Clear.
	19	9 a. m.......	650.8	5.5	651.4	5.5	25.555	25.622	34	Clear and pleasant.
	19	12 m........	650.8	9	651.4	9	25.558	25.582	40	Clear.
	19	3 p. m.......	650.8	11	650.9	11	25.605	25.609	42	Do.
	20	Sunrise......	650.3	4.5	651	4.5	25.563	25.591	25	A few light clouds in northwest.
	20	9 a. m.......	650.3	6	651	6	25.535	25.567	38	Light clouds.
	20	12 m........	650.3	7	651	7	25.546	25.578	38	Cloudy; at 2 p. m. slight fall of snow.
	20	3 p. m.	650	7.5	649.8	7.5	25.589	25.578	40	Broken clouds, with signs of snow.
	21	9 a. m.......	651.1	5	651.8	5	25.574	25.698	38	Broken clouds; snow fell during the night; depth one inch.
	21	12 m........	652.7	9	652.7	9	25.633	25.633	41	Light clouds.
	21	3.30 p. m....	652.9	9	652.8	9	25.703	25.699	41	Clear; light breeze from northwest.
	22	9 a. m.......	656.1	6	653.4	6	25.768	25.736	34	Clear; light breeze from south.
	22	12 m........	656.3	9	656.3	9	25.775	25.775	40	Clear.
	22	3 p. m.......	656.3	10	656.3	10	25.826	25.826	46	Light clouds.
	23	9 a. m.......	653	6.5	651.7	6.5	25.642	25.630	45	Cloudy.
	23	12 m........	652.4	6.5	651.2	6.5	25.633	25.586	46	Cloudy, with signs of rain.
	23	3 p. m.......	651.8	6	651	6	25.664	25.637	39	Rain; 4.20 p. m. snow commenced to fall.
	24	9 a. m.......	653	5	652.5	5	25.649	25.626	37	Thermometer at sunrise 37°.
	24	12 m........	653.1	6.5	653.8	6.5	25.660	25.684	44	Slight fall of snow.
	24	3 p. m.......	653.1	7	653.8	7	25.715	25.739	40	Light clouds.
	25	9 a. m.......	653.2	5	653.7	5	25.657	25.673	34	Clear.
	25	12 m........	653.3	8	653.8	8	25.660	25.680	40	Clear and pleasant.
	25	3 p. m.......	652.7	10	651.2	10	25.684	25.625	40	Cloudy, with signs of snow.
	26	9 a. m	648.9	5	648.1	5	25.484	25.456	34	Snow falling very fast; strong wind from northwest.
	26	12.30 p. m...	649.3	5	648.6	5	25.525	25.497	35	Snow falling very fast; strong wind from northwest.
	26	3 p. m.......	649.9	8	649.7	8	25.582	25.574	40	Cloudy.
	27	9 a. m.......	649.9	3	649.7	3	25.531	25.523	37	Do.
	27	12 m........	650.4	8	651.4	8	25.546	25.586	46	Light clouds.
	27	3 p. m.......	650.4	8.5	651.2	8.5	25.601	25.633	47	Cloudy in the northwest.
	28	9 a. m.......	643.9	6	643.1	6	25.287	25.256	47	Light fall of snow.
	28	12 m........	644.2	8	643.6	8	25.306	25.286	46	Cloudy in the northwest; strong wind from southeast.
	28	3 p. m.......	644.2	10	643.6	10	25.353	25.326	46	Slight fall of snow.
	March 1	9 a. m.......	646.2	4	647.8	4	25.386	25.445	37	Cloudy, with signs of snow.
	1	12 m........	646.8	5	648.9	5	25.420	25.499	42	Snow falling fast; strong wind from northwest.
	2	9 a. m.......	651.2	4	651.4	4	25.582	25.586	33	Light clouds.
	2	12 m........	651.6	7	651.4	7	25.601	25.589	43	Do.
	2	3 p. m.......	651.6	7	651.4	7	25.656	25.644	44	Cloudy.
	3	9 a. m.......	651.2	4.5	651.8	4.5	25.578	25.698	32	Clear; snow fell during the night to the depth of an inch.
	3	12 m........	651.6	8	652.3	8	25.593	25.621	39	Clear.
	4	9 a. m.......	648.7	5	647.7	5	25.476	25.437	46	Cloudy; light wind from south.
	4	12 m	648.1	7	647.2	7	25.464	25.428	48	Cloudy, with strong wind from south.
	4	3 p. m.......	646.8	6	646.5	6	25.471	25.460	47	Cloudy, with signs of snow; 4.30 p. m. snowing heavily.
	5	9 a. m.......	647.7	6	648.3	6	25.433	25.456	44	Slight fall of snow; strong wind from northwest.
	5	12 m	647.7	7	648.3	7	25.444	25.467	49	Snow falling fast.
	5	3 p. m.......	647.9	8	648.3	8	25.503	25.519	42	Cloudy.
	6	9 a. m.......	647.6	5.5	648.1	5.5	25.433	25.452	42	Snow.
	6	12.20 p. m...	647.6	8	648.1	8	25.441	25.465	56	Cloudy.
	6	3 p. m.......	647.5	8	648	8	25.487	25.511	54	Fine snow.
	7	9 a. m.......	648	5.5	650.4	5.5	25.449	25.472	48	Cloudy.
	7	12 m	649.2	8.5	650.4	8.5	25.499	25.546	42	Clear.
	7	3 p. m.......	649.7	11	647.7	11	25.562	25.589	40	Do.
	8	9 a. m.......	648.2	6	647.7	6	25.456	25.433	43	Cloudy.
	8	12 m	648.1	8	651.1	8	25.460	25.440	46	Do.
	9	9 a. m.......	650.6	5	643.8	5	25.551	25.574	38	Clear and pleasant.
	12	9 a. m.......	644.1	7	646.6	7	25.291	25.279	45	Do.
	13	9 a. m.......	645	5.5	646.9	5.5	25.331	25.393	34	Snow.
	13	12 m	645.3	9	649.7	9	25.346	25.408	49	Cloudy; three inches of snow on the ground.
	15	12 m	648.3	12.5	650.4	12.5	25.448	25.499	54	Clear.
	16	9 a. m.......	649.3	10.5	651.1	10.5	25.476	25.523	50	Do.
	16	12 m	649.6	13.5	649.9	13.5	25.491	25.554	64	Light clouds.
	17	9 a. m.......	651.5	11.5	648.6	12	25.559	25.496	49	Do.
	20	9 a. m.......	648.1	11	648.8	11	25.429	25.456	50	Rain, accompanied by thunder and lightning.
	20	12 m	648.6	12	648.3	12	25.460	25.448	44	Stormy.
	21	9 a. m.......	652.4	11	652.2	11	25.598	25.590	49	Cloudy.
	21	12 m	654.7	13.8	653.5	14	25.692	25.645	57	Rain.
	21	3 p. m.	652.3	16.5	653.6	17	25.641	25.688	54	Clear.
	22	9 a. m.......	655.2	8	653.8	8	25.681	25.622	47	Do.
	22	12 m	655.2	13	653.8	13	25.716	25.657	53	Do.
	22	3 p. m......	655.2	16	653.8	16	25.759	25.700	57	Do.
	23	9 a. m.......	655.3	12	653.6	12	25.708	25.642	52	Do.
	23	12 m	655.2	13.5	653.9	14	25.716	25.657	54	Do.
	24	9 a. m.......	649.8	17	648.6	17	25.538	25.495	59	Light clouds.
	24	12 m	652.6	12	651.4	12	25.602	25.555	49	Light clouds; strong breeze from northwest.

II.—*Meteorological Observations at Great Salt Lake City*—Continued.

Locality.	Date.	Hour.	Barometer, No. 496.	Attached thermometer, (C.)	Barometer, No. 551.	Attached thermometer, (C.)	Corrected barometer, No. 496.	Corrected barometer, No. 551.	Air temperature, (F.)	Remarks.
	1854.						*Inches.*	*Inches.*		
Great Salt Lake City..	Mar. 24	3 p. m.......	651	14	649.7	14	25.546	25.495	58	Light clouds.
	25	9 a. m.......	649.8	11.5	649.3	11.5	25.492	25.472	49	Do.
	25	12 m	650.2	15	649.6	15	25.511	25.487	57	Do.
	26	9 a. m.......	650 3	11.3	649.5	11.3	25.516	25.484	54	Do.
	26	12 m	650.6	15.5	650	15.5	25.523	25.503	59	Clear.
	27	9 a. m.......	650.4	13	650	12	25.512	25.496	59	Light clouds.
	27	12 m	650.7	16.5	650	16.5	25.523	25.511	68	Do.
	28	12 m	650.6	15.5	650	15.5	25.523	25.503	59	Slight fall of rain.
	28	3 p m.......	651.3	16.6	651	16.7	25.601	25.593	63	Cloudy.
	29	9 a. m.......	653.4	14.8	652.6	15	25.622	25.590	58	Light clouds.
	29	12 m	649.3	16.9	648	17	25.467	25.416	61	Clear.
	29	3 p. m.......	647	19	648.2	19.5	25.424	25.471	62	Do.
	30	9 a. m.......	649.7	11.5	648.8	11.5	25.488	25.452	39	Snow and rain, with strong wind from northwest.
	30	12 m	649.9	12.5	649.2	12.5	25.507	25.483	35	Snow and rain, with strong wind from northwest.
	30	3 p. m.......	649.9	10	649.2	10	25.574	25.546	36	Cloudy.
	April 1	9 a. m.......	659	10.5	656.6	10.5	25.862	25.760	51	Do.
	1	12 m	659.6	12.5	655.9	12.5	25.889	25.743	55	Do.
	2	9 a. m.......	656.3	11	655.4	11	25.752	25.716	52	Slight fall of rain.
	2	12 m	656.1	15	654.5	15.5	25.743	25.676	68	Cloudy.
	2	3 p. m.......	654.9	15	653.4	15	25.747	25 692	69	Light clouds.
	4	9 a. m.......	....	....	654.3	10	....	25.677	54	Do.
	4	12 m	....	....	659.1	16.6	....	25.853	60	Wind from southwest; clear.
	4	3 p. m	....	....	658.5	19.8	....	25.869	64	Do. do.
	5	9 a. m.......	....	....	657	16	....	25.760	62	Light clouds.
	5	12 m	....	....	655	18.5	....	25.684	68	Light northwest wind.
	5	3 p. m.......	....	....	654.4	21	....	25.704	71	
	6	6 a. m.......	....	....	648.4	15	....	25.458	47	Thermometer at sunrise 21°.
	6	9 a. m.......	....	....	654.4	21	....	25.634	57	
	6	12 m	....	....	653.9	16.1	....	25.649	59	
	6	3 p m.......	....	....	649	....	....	....	42	
	7	Sunrise......	....	....	648.1	11	....	25.456	42	Thermometer at sunrise 42°.
	7	12 m	....	....	649.2	11.5	....	25.472	47	
	7	3 p. m.......	....	....	646	12	....	25.361	51	Wind north.
	7	Sundown......	....	....	654	13.7	....	25.723	44	
	8	Sunrise......	....	....	648.5	11.6	....	25.511	35	Clear; thermometer at sunrise 35°.
	8	9 a. m.......	....	....	651.2	9.5	....	25.586	41	
	8	Noon	....	....	648.7	10	....	25.456	48	Wind northwest.
	8	3 p. m.......	....	....	648.8	12.7	....	25.464	49	
	8	Sundown......	....	....	653.4	16	....	25.688	48	Light clouds.
	9	Sunrise......	....	....	658.8	15.5	....	25.901	34	Thermometer at sunrise 40°.
	9	9 a. m.......	....	....	651.3	9.4	....	25.590	46	
	9	Noon	....	....	651.5	10	....	25.567	56	Clear; wind south.
	9	3 p. m.......	....	....	647.1	11.8	....	25 460	52	
	9	Sundown......	....	....	647	12.7	....	25.452	51	
	10	Sunrise......	....	....	647.4	9	....	25.440	39	
	10	9 a. m.......	....	....	647.5	9.5	....	25.413	37	
	10	Noon........	....	....	649	11	....	25.483	44	Rained until 11 a. m.
	10	3 p. m.......	....	....	649.1	15	....	25.522	52	Wind northwest; clear.
	10	Sundown......	....	....	649.6	14.7	....	25.542	49	Clear; wind southeast.
	11	Sunrise......	....	....	649.8	9.5	....	25.523	41	
	11	9 a. m.......	....	....	649.6	10	....	25.492	54	
	11	Noon........	....	....	649.9	12.5	....	25.507	56	Wind northwest.
	11	3 p. m.......	....	....	647.8	14	....	25.475	57	Cloudy.
	12	9 a. m.......	....	....	648.3	9	....	25.445	44	Thermometer at sunrise 40°.
	12	Noon........	....	....	650.8	10	....	25 554	49	Hail and rain; wind north.
	12	3 p. m.......	....	....	651.8	10.5	....	25.644	45	Do. do.
	12	Sundown......	....	....	646.8	10.6	....	25.452	47	Rain; wind north.
	13	9 a. m.......	....	....	655.1	9	....	25.712	42	Thermometer at sunrise 38°.
	13	Noon........	....	....	643	8.5	....	25.255	51	Clear; wind northwest.
	13	3 p. m.......	....	....	655.4	14.7	....	25.771	52	
	13	Sundown......	....	....	654.5	13	....	25.743	49	
	14	9 a. m.......	....	....	656.4	11	....	25.756	49	Thermometer at sunrise 44°.
	14	Noon........	....	....	655.6	13	....	25.731	56	
	14	3 p. m.	....	....	656.4	16	....	25.806	59	Clear; wind northwest.
	14	Sundown......	....	....	654.8	16	....	25.739	57	
	15	9 a. m.......	....	....	655.7	12	....	25.724	54	Thermometer at sunrise 50°; clear; wind northwest.
	15	Noon........	....	....	652.8	15.5	....	25.609	64	
	15	3 p. m.......	....	....	653.5	18	....	25.680	66	
	15	Sundown......	....	....	659.1	17.7	....	25.904	63	
	16	9 a. m.......	....	....	652.8	14	....	25.598	54	Thermometer at sunrise 49°; wind west; unsteady all day.
	16	Noon........	....	....	651.9	17.7	....	25.562	69	Light clouds.
	16	3 p. m.......	....	....	650.7	20	....	25.562	71	
	16	Sundown......	....	....	650.2	20.4	....	25.542	69	
	17	9 a. m.......	....	....	650.1	15	....	25.492	60	Thermometer at sunrise 50°; wind south; clear.
	17	Noon........	....	....	650.6	20	....	25.503	72	
	17	3 p. m.......	....	....	650.4	22.5	....	25.542	74	
	17	Sundown......	....	....	649.4	20.8	....	25.511	69	Wind northeast.
	18	9 a. m.......	....	....	649	17	....	25.441	67	Thermometer at sunrise 54°; light clouds, wind southeast.
	18	Noon........	....	....	648.7	22	....	25.420	75	Southerly wind.
	18	3 p. m.......	....	....	646.8	25.5	....	25.393	79	Light clouds.
	18	6 p. m.......	....	....	646.2	20.7	....	25.385	69	Cloudy.

II.—*Meteorological Observations at Great Salt Lake City*—Continued.

Locality.	Date.	Hour.	Barometer, No. 496.	Attached thermometer, (C.)	Barometer, No. 551.	Attached thermometer, (C.)	Corrected barometer, No. 496.	Corrected barometer, No. 551.	Air temperature, (F.)	Remarks.
	1854.						*Inches.*	*Inches.*		
Great Salt Lake City..	April 19	9 a. m.	....	....	647.7	15	....	25.397	48	Rain during the night; thermometer at sunrise 51°.
	19	Noon	....	....	648	15	....	25.424	52	At 7 a. m. rain, wind west; at 9 a. m., south wind; noon clear.
	19	3 p. m.	....	....	647.1	19.8	....	25.428	57	Wind southeast.
	19	Sundown	....	....	647.5	17	....	25.452	54	Light clouds.
	20	Sunrise	....	....	646.7	13.7	....	25.399	47	Thermometer at sunrise 47°; rain until 7 a. m.
	20	9 a. m.	....	....	646.9	14	....	25.374	50	Rain from 10 to 12.
	20	Noon	....	....	647.1	14.8	....	25.393	46	Clear.
	20	3 p. m.	....	....	647.6	18.5	....	25.448	59	Thunder; cloudy in the southwest.
	20	6.15 p. m.	....	....	646.1	16	....	25.404	55	
	22	Sunrise	....	....	644	10	....	25.306	42	Northwest wind; heavy clouds in the east.
	22	9 a. m.	....	....	643.9	11.5	....	25.296	47	Cloudy.
	22	Noon	....	....	643.9	12.7	....	25.292	49	Commenced to rain at 10 a. m.
	22	3 p. m.	....	....	643.6	11	....	25.286	43	Rain.
	22	6.20 p. m.	....	....	644.2	11	....	25.310	44	Rain ceased at 4½ p. m.; wind northeast.
	23	Sunrise	....	....	642.8	9	....	25.263	41	Cloudy in the east; heavy rain during the night.
	23	9 a. m.	....	....	642.5	10.5	....	25.246	50	Northwest wind and flying clouds.
	23	Noon	....	....	642	11.5	....	25.222	57	Northwest wind and flying clouds.
	23	3 p. m.	....	....	640.4	14.5	....	25.147	56	High wind.
	23	Sundown	642	13	640.9	13	25.216	25.173	54	Rain.
	24	Sunrise	643.1	11	642.7	10.5	25.266	25.254	44	Heavy rain during the night.
	24	9 a. m.	647.7	11	645.9	11.5	25.447	25.375	46	Rain; wind northwest.
	24	Noon	645.2	12	646.1	12	25.345	25.380	49	Heavy clouds.
	24	3 p. m.	645.3	14	647 8	13.5	25.341	25.441	54	Northeast wind; clearing up.
	24	Sundown	645.4	15.4	646.7	15	25.339	25.391	53	Northeast wind; clear.
	25	Sunrise	644.8	10	644.6	10.5	25.337	25.328	41	Wind south.
	25	9 a. m.	643.5	13	644.1	12.8	25.275	25.300	57	High wind from the south, with heavy clouds.
	25	Noon	644.8	13.4	645.5	13	25.323	25.354	56	High wind from the south, with heavy clouds.
	25	3 p. m.	643.6	16	644.3	15.6	25.266	25.295	59	Southerly wind; light clouds.
	25	4.30 p. m.	644.1	14.7	644.8	14.0	25.291	25.322	53	Heavy squall of wind from southwest, with rain.
	25	6.20 p. m.	644.6	10.5	645.1	10	25.307	25.249	43	Wind changed to northwest; cold rain.
	26	Sunrise	648.8	9.5	649.2	10	25.507	25.510	37	Rain all night; snow in the eastern mountains.
	26	9 a. m.	649.9	10	650.7	10 5	25.538	25.567	51	Wind south, with heavy clouds.
	26	Noon	650.9	12.6	651.4	12.8	25.567	25.586	51	Wind northwest; heavy squall of rain; duration 20 minutes.
	26	3 p. m.	651.6	14.9	651.7	14.9	25.585	25.589	52	Wind northwest; heavy clouds.
	26	Sundown	652.7	14.5	651.7	14.6	25.630	25.591	49	Do. light clouds.
	27	Sunrise	652.9	9	651.5	9.5	25.659	25.603	36	Wind northeast; light clouds; frost during the night.
	27	9 a. m.	653.2	12	653.7	12	25.660	25.680	50	Wind southwest; clear.
	27	Noon	652.4	14.9	653.5	14	25.615	25.672	55	Wind northwest; clear.
	27	3 p. m.	652.4	16	653.4	15.8	25.612	25.652	60	Wind northwest; cloudy.
	27	6.30 p. m.	653	14	652.5	14.4	25.644	25.622	54	Wind west; cloudy.
	28	Sunrise	650.9	10.5	652.5	11	25.575	26.636	43	Wind northeast; light clouds.
	28	9 a. m.	652.2	14.9	651.9	14	25.609	25.601	61	Wind northwest; cloudy.
	28	Noon	651.7	17	651.4	16.4	25.581	25.571	68	Do do.
	28	3 p. m.	650.7	19.2	650.6	18.8	25.531	25.530	68	Wind northwest; hazy.
	28	Sundown	650.6	17	649.3	17	25.537	25.486	61	Wind west; hazy.
	29	Sunrise	648.8	14.1	648	15	25.479	25.442	55	Wind northeast; cloudy in the west.
	29	9 a. m.	648.4	17.5	648.6	17	25.448	25.458	69	Wind northeast; hazy.
	29	Noon	647.9	20	646.7	19.5	25.418	25.373	78	Wind southeast; light clouds.
	29	3 p. m.	645.6	20.3	643.7	19.8	25.327	25.254	73	Wind southeast; cloudy.
	29	Sundown	644.5	17	642.8	17.8	25.297	25.227	65	Wind northeast; heavy clouds.
	30	Sunrise	642.4	16	640.5	16	25.219	25.145	59	Do do.
	30	9 a. m.	643.3	17.2	642.9	17	25.249	25.235	62.5	Wind southeast; heavy clouds.
	30	Noon	642.2	18.9	644.1	18.5	25.200	25.276	67	Wind south; heavy clouds in the west.
	30	3 p. m.	642.5	19.5	645.4	19	25.206	25.325	65	Wind southwest; heavy clouds.
	30	Sundown	643.9	17	644.8	17	25.273	25.309	59	Wind northwest; heavy clouds.
	May 1	Sunrise	644.7	15.4	646.6	15	25.311	25.387	47	Wind southeast; heavy clouds.
	1	9.30 a. m.	645.5	16	647	16	25.341	25.400	59	Wind northwest; heavy clouds.
	1	Noon	646.1	19	648.6	18.5	25.352	25.453	66	Wind southeast; heavy clouds.
	1	3 p. m.	645.5	18	648.3	18	25.332	25 442	62.5	Wind northwest; heavy clouds.
	1	6.30 p. m.	646.5	16.8	647.9	17	25.377	25.431	53	Wind northeast; cloudy.
	2	Sunrise	647.3	15	647.9	14.6	25.415	25.441	47	Cloudy; westerly wind.
	2	9 a. m.	647.3	17	649.6	16.1	25.408	25.501	62	Cloudy; wind northwest.
	2	Noon	647.2	19	650.6	18.9	25.396	25.490	68	Do do.
	2	3 p. m.	647.2	21	649.7	20.9	25.388	25.520	68.5	Light clouds in northwest.
	2	Sundown	648	19.3	649.1	19	25.426	25.471	61.5	Clear; wind northwest.
	3	Sunrise	648	15.9	649.3	15.9	25.439	25.490	52	Clear; easterly wind.
	3	9 a. m.	648.1	17	649.8	16.1	25.455	25.510	62	Clear; westerly wind.
	3	Noon	647.3	19	650	18.9	25.400	25.506	67	Clear; northwest wind.
	3	3 p. m.	647.5	23.2	649.4	22.5	25.390	25.467	71	Do do.
	3	6.30 p. m.	648.1	21	649.1	21	25.422	25.462	65.5	Do do.
	4	Sunrise	648.7	16.5	649.9	16.8	25.465	25.510	50	Clear; easterly wind.

II.—*Meteorological Observations at Great Salt Lake City*—Continued.

Locality.	Date.	Hour.	Barometer, No. 496.	Attached thermometer, (C.)	Barometer, No. 551.	Attached thermometer, (C.)	Corrected barometer, No. 496.	Corrected barometer, No. 551.	Air temperature, (F.)	Remarks.
	1854.						*Inches.*	*Inches.*		
Great Salt Lake City..	May 4	9 a. m.......	648.5	18.9	650	18.5	25.447	25.508	65	Clear; westerly wind.
	4	Noon........	648.6	21	649.6	20.3	25.442	25.484	71	Do.
	4	3 p. m.......	648.2	23.5	648.6	23	25.416	25.446	74	Do.
	4	Sundown....	648.5	22.3	647.6	22	25.433	25.398	68.5	Clear; north wind.

The altitude of the place of observation in Great Salt Lake City, as deduced from the mean of all the foregoing observations, is 4,351 feet above the sea.

III.—*Summary of meteorological observations at Great Salt Lake City in* 1853 *and* 1854, *in mean results at each observed hour for the several months; barometric readings corrected for temperature.*

	Barometer No. 496.				Barometer No. 551.				Mean of both barometers.	Air temperature.				Remarks.
	9 a. m.	12 m.	3 p. m.	Month.	9 a. m.	12 m.	3 p. m.	Month.		9 a. m.	12 m.	3 p. m.	Month.	
										°	°	°	°	
December, 1853.	25.673	25.664	25.665	25.667	25.672	25.678	25.656	25.669	25.668	36.57	42.90	45.10	41.52	30 observations at 9 a. m.; 22 at 12 m.; 19 at 3 p. m.
January, 1854 ..	25.624	25.592	25.558	25.591	25.613	25.584	25.547	25.581	25.586	24.20	28.35	24.43	25.66	26 observations at 9 a. m.; 21 at 12 m.; 17 at 3 p. m.
February, 1854..	25.593	25.585	25.570	25.583	25.592	25.581	25.558	25.577	25.580	35.46	41.12	39.60	38.73	28 observations at 9 a. m.; 26 at 12 m.; 21 at 3 p. m.
March, 1854.....	25.543	25.542	25.535	25.540	25.543	25.542	25.535	25.540	25.540	40.50	50.80	50.60	47.30	23 observations at 9 a. m.; 22 at 12 m.; 11 at 3 p. m.
April, 1854......	25.501	25.460	25.379	25.447	25.574	25.545	25.531	25.550	25.550	52.40	58	59.80	56.73	Observations of barometer 551, and or temperature full for the month. Barometer 496 observed 9 days only.
May, 1854.......	25.453	25.422	25.351	25.409	25.519	25.508	25.439	25.489	25.449	62	68	68.80	66.30	Observations for the first four days only.

IV.—*Barometric means for the months observed at Great Salt Lake City,* 1853–'54, *from all the observations, including those at irregular hours, and corrected in detail for horary variation of pressure.*

	Barometer No. 496.	Barometer No. 551.	Mean of both barometers.	Remarks.
December, 1853..............................	25.651	25.651	25.651	The mean of the last column is used for the determination of the altitude of Salt Lake City, 25.573, with a mean air temperature, for this period of five months, of 45° F.
January, 1854................................	25.581	25.577	25.579	
February, 1854................................	25.569	25.565	25.567	
March, 1854	25.513	25.520	25.517	Altitude 4,351 feet.
April, 1854.......	....	25.552	25.552	

V.—*Meteorological Observations and Table of Altitudes and Distances from Great Salt Lake City to Green River—April*, 1854.

Station.	Date.	Hour.	Distance from Great Salt Lake City.	Barometric reading. (Bar. No. 495.)	Attached thermometer, (C.)	Air thermometer.	Corrected barometer.	Barometric means.	Altitude above the sea.
	1854.								
Session Settlement	April 4	5 p. m.	10.50	661.4	18	65	26.011	....	4183.2
	4	Sunset	....	661	13	56	25.991		
	5	Sunrise	....	658.8	7	45	25.903		
	5	6 a. m.	....	658.4	8.5	49	25.879		
	5	7.15 a. m.	....	658.9	11	53	25.867	25.930	
On hill, en route	5	1 p. m.	....	645	26.5	76	25.283		
Weber river, north side	5	1.45 p. m.	29	653.6	25	76	25.634	....	4430.1
Camp 2, Weber river	5	6 p. m.	36.80	643.4	15	60	25.302	....	4842
	5	6.30 p. m.	....	643.5	12	54	25.313		
	6	Sunrise	....	638.2	0.2	35	25.115		
	6	6.30 a. m.	....	638	4.5	40	25.086		
	6	7.15 a. m.	....	638.1	7.5	45	25.069	25.177	
On march, Sheep rock	6	12.15 p. m.	49	636.1	17.5	64	24.953	....	5189.5
Camp 3, Dry creek	6	4.30 p. m.	57.50	625.3	8	48	24.634	....	5419.1
	7	6.10 a. m.	....	625	2.5	36	24.585		
	7	7 a. m	....	625	2.5	36	24.575		
	7	7.30 a. m.	....	624.9	2.5	36	24.566	24.590	
	7	9.30 a. m.	....	624.3	7	49	24.507		
Camp 4, White Clay creek	7	3.30 p. m.	64	616	6.5	47	24.262	....	5692.1
	7	4 p. m.	....	615.9	5	42	24.274		
	7	5 p. m.	....	615.9	3	39	24.287		
	7	6 p. m.	....	615.3	2	36	24.247		
	7	7 p. m.	....	615.3	1	33	24.241		
	8	5 a. m.	....	618.3	—2.5	28	24.355		
	8	5.30 a. m.	....	618.3	—2.5	27	24.352		
	8	6 a. m.	....	619.6	1	29	24.483		
	8	7 a. m.	....	619.8	3	32	24.370	24.308	
On hill, en route	8	12.30 a. m.	77.25	596.6	3	37	23.450	....	6562.1
Camp 5, near divide of the waters of Bear and Weber river, side of mountain.	8	4.40 p. m.	87.40	585.7	0	32	23.119		
	8	5 p. m.	....	585.7	0	32	23.121		
	8	6 p. m.	....	585.5	—4	23	23.101		
	8	6.30 p. m.	....	585.2	—4.5	21	23.096		
	9	Sunrise	....	583.2	—9.5	10	22.991		
	9	5.30 a. m.	....	582.8	—9.5	11	22.988		
	9	6 a. m.	....	582.8	—9.5	13	22.986		
	9	7 a. m.	....	584.3	—4	20	23.012	23.052	
Divide	9	9 a. m.	90.00	573.3	7	37	22.519	....	7749.7
Divide	9	11 a. m.	91.50	577.5	4.5	40	22.662	....	7490.8
Bear river valley	9	1 p. m.	96.20	575	5	41	22.614	....	7551.7
Camp 6, Sulphur creek	9	4 p. m.	104.40	576.1	2	40	22.723	....	7494.5
	9	5 p. m.	....	575.2	0	32	22.688		
	9	6.30 p. m.	....	574.8	—2	28	22.663		
	10	5.30 a. m.	....	572.9	—3	25	22.556		
	10	6 a. m.	....	573.3	—1.5	29	22.572		
	10	6.30 a. m.	....	572.4	1.5	37	22.507		
	10	7 a. m.	....	572.1	3.5	42	22.500	22.601	
Divide of Bear and Muddy	10	10.30 a. m.	109.60	561.2	3	37	22.034	....	8133.3
Camp 7, Muddy river	10	2.30 p. m.	115.60	570.7	4	36	22.476	....	7779.1
	10	3.30 p. m.	....	569.8	3	34	22.459		
	10	4.30 p. m.	....	569.3	1.5	33	22.457		
	10	5 p. m.	....	569.3	1.5	33	22.460		
	10	6 p. m.	....	569.3	—0.5	32	22.445		
	11	5 a. m.	....	570.3	—2.5	26	22.464		
	11	5.30 a. m.	....	570.3	—2.5	27	22.461		
	11	6 a. m.	....	570	—1.5	29	22.435	22.445	
Divide of Muddy and Black's forks	11	8 a. m.	120.60	559.4	5.5	41	21.978	....	8373.9
Black's fork	11	9.40 a. m.	124.60	570.9	6	46	22.406	....	7880.5
Smith's fork, camp 8	11	3.30 p. m.	....	580.9	7.5	49	22.877		
	11	4 p. m.	....	580.9	7	47	22.885		
	11	4.30 p. m.	....	580.9	7	47	22.887		
	11	5 p. m.	....	580.4	5.5	43	22.885		
	12	5.45 a. m.	....	580.5	—0.5	32	22.850		
	12	6.45 a. m.	....	580.5	0	32	22.839	22.870	
Cottonwood	12	1 p. m.	....	584.2	8	51	22.965	....	7263.9
Camp 9, Henry's fork	12	7 p. m.	156.30	587.6	0.5	34	23.145	....	7136.6
	13	5.30 a. m.	....	585.8	—0.4	24	23.065		
	13	6 a. m.	....	585.8	—0.3	27	23.061		
	13	6.30 p. m.	....	587.3	2	34	23.136		
	14	5.30 a. m.	....	587.8	—0.5	20	23.142	23.110	
Mountain peak, overlooking country; (end of eastern course.)	13	11 a. m.	169.50	571.9	7	34	22.435	....	8067.8
Dry Timber creek; (return trip)	13	1.30 p. m.	163.10	594 4	13	50	23.355	....	7024 7
			Distance f'm Green river.						
Top of pass, between Smith's & Henry's forks	14	8 a. m.	31.50	582.9	6	40	22.890	....	7529.6
Camp 10, Smith's fork	14	5.30 p. m.	54	594.4	13	50	23.395	....	6970.8
	14	6.30 p. m.	....	594.1	7.5	44	23.385		
	14	6.46 p. m.	....	593.9	5.5	41	23.382		
	15	6.40 a. m.	....	595.7	7.5	35	23.410		
	15	7 a. m.	....	595.9	14	39	23.390	23.392	
Divide of Muddy and Black's fork	15	11 a. m.	65	584.8	15	56	22.915	....	7446.9
Camp 11, Muddy creek	15	1.05 p. m.	69.75	596.8	22.5	76	23.415	....	6964.2
	15	3 p. m.	....	596.8	22	69	23.450		
	15	5 p. m.	....	595.4	21	61	23.417		
	16	Sunrise	....	592.6	—5	22	23.328		

V.—*Meteorological Observations, and Table of Altitudes and Distances*—Continued.

Station.	Date.	Hour.	Distance from Green river.	Barometric reading. (Bar. No. 496.)	Attached thermometer, (C.)	Air thermometer.	Corrected barometer.	Barometric means.	Altitude above the sea.
	1854.								
Camp 11, Muddy creek	April 16	6.30 a. m.	....	593.3	7	43	23.317	23.385	
Camp 12, Bear river	16	3 p. m.	94.25	586.5	17	66	23.062	28.444	7195.6
	16	4.30 p. m.	....	586.3	16.5	63	23.067		
	16	5.30 p. m.	....	585.7	14	58	23.050		
	16	6.30 p. m.	....	584.7	5.5	42	23.025		
	17	5.30 a. m.	....	585.1	0	31	23.030		
	17	5.58 a. m.	....	585.2	2.5	36	23.025	23.043	
Near upper camp, on White Clay creek	17	10 a. m.	105.25	592.3	21	69	23.195	....	7009.2
Camp 13, White Clay creek	17	1.30 p. m.	114.45	601.2	22.5	75	23.588	....	6534.6
	17	3.30 p. m.	....	601.7	26	73	23.632		
	17	5 p. m.	....	601	22.5	69	23.630		
	18	5.30 a. m.	....	598.3	2.5	35	23.542		
	18	6.25 a. m.	....	598.2	2.5	36	23.531		
	18	6.45 a. m.	....	598.9	5	39	23.544	23.578	
First summit	18	9 a. m.	117.95	585.5	19.5	65	22.940	....	7270
High summit	18	2 p. m.	126.70	556	17	60	21.846	....	8618.9
Camp 14, side of mountain	18	3 p. m.	....	560.2	17	60	22.027	....	8335.4
	18	3.30 p.	....	560.1	16.5	59	22.027		
	18	4 p. m.	....	560	13.5	56	22.045		
	18	6.30 p. m	....	559.4	9	47	22.015		
	19	Sunrise	....	556.9	2	36	21.915		
	19	7 a. m.	....	556.6	2	37	21.895	21.987	
Camp 15, Weber river	19	5 p. m.	145.95	616.1	13.5	59	24.259	....	5672.1
	19	5.30 p. m.	....	616.3	13.5	57	24.257		
	19	6 p. m.	....	616.3	13	54	24.286	24.267	
	20	Sunrise	....	614.8	5	42	24.183		
	20	6.30 a. m.	....	614.9	7	43	24.168		
	20	7.17 a. m.	....	614.3	6.5	43	24.139		
Weber river at Kamas prairie	20	11.30 a. m.	157.95	602.1	9	57	23.630	....	6319.6
Divide on Kamas prairie	20	2 p. m.	....	598	8.5	46	23.525	....	6505
Bank of Timpanogos river	20	3 p. m.	166.65	603.9	12	52	23.759	....	6242.8
	20	3 10 p. m.	....	603.8	11.5	51	23.761	23.760	
Camp 16, near river	20	5 p. m.	....	591	7	45	23.290	....	6775.6
	20	6 p. m.	....	591	5	42	23.279		
	21	6 a. m.	....	589.9	6.5	42	23.193		
	21	6.35 a. m.	....	590.1	6.5	43	23.195		
	21	7 15 a. m.	....	590.3	3.5	39	23.207	23.233	
Timpanogos river	21	8 a. m.	172.35	607.4	9	53	23.841	....	6055.7
Head of long plain	21	11 a. m.	177.75	615.4	11.5	52	24.130	....	5739
Foot of hill before passing over a spur	21	12 m.	182.75	620.4	14.5	64	24.341	....	5516.9
River bank	21	12.40 p. m.	183.45	620.8	16.5	65	24.362	....	5494
Head of cañon	21	2 p. m.	188.15	621.7	15	60	24.433	....	5484.5
Still in cañon	21	3 p. m.	191.15	623.2	14	59	24.511	....	5390.3
Camp 17, Timpanogos river	21	6.30 p. m.	199.15	627.3	13	55	24.671	....	5056.9
	21	7 p. m.	....	627	11	53	24.662		
	22	5.30 a. m.	....	628	3	37	24.711		
	22	6 a. m.	....	628	5	42	24.698		
	22	6 30 a. m.	....	628	7	46	24.683	24.685	
Camp 107, 1853, American fork	Nov. 5	3 p. m.	213.35	647.5	19	68	25.448	....	4596.2
	5	6 p. m.	....	646	12	52	25.416		
	5	9 p. m.	....	646	9	48	25.398		
	6	6 a. m.	....	645.7	6	42	25.391	25.411	
Great Salt Lake City	April 22	....	248						

VI.—*Data for profile from Smith's Fork, Green River valley, to that of Great Salt lake, via the Timpanogos river.*

Station.	Date.	Hour.	Intermediate distances.	Distance from Smith's Fork.	Altitudes above the sea.
	1854.				
Smith's Fork, near Fort Bridger	April..11, 12	Camp			7254.4
Black's Fork	April.....11	9.40 a. m		9.00	7880.3
Divide of Black and Muddy	April.....11	8 a. m	12.25	21.25	8373.7
Divide of Bear and Muddy	April.....10	10.30 a. m	6.10	27.35	8133.3
Divide of Bear and White Clay creek	April.....9	11 a. m	12.90	40.25	7490.8
White Clay creek	April.....17	10 a. m	11.50	51.75	7009
White Clay creek, Camp 13	April..17, 18	Camp	8.75	60.50	6534.4
White Clay creek, Camp 4	April...7, 8	Camp	10.00	70.50	5692.1
Weber river, Camp 15	April..19, 20	Camp	5.25	75.75	5671.9
Kamas prairie	April.....20	11.30 a. m	12	87.75	6319.4
Timpanogos river	April.....20	3 p. m	8.70	96.45	6242.6
	April.....21	8. a. m	5.70	102.15	6055.5
Timpanogos river, head of Round prairie	April.....21	11 a. m	5.20	107.35	5738.8
Timpanogos river	April.....21	12 m	5	112.35	5516.7
Timpanogos river, foot of Round prairie	April.....21	12.40 p. m	0.70	113.05	5493.8
Timpanogos river, head of cañon	April.....21	2 p. m	4.70	117.75	5484.3
	April.....21	3 p. m	3	120.75	5394.1
Camp near foot of cañon	April.....21	Camp	8	128.75	5076.7
American Fork	Nov. 6, 1853		14.20	142.95	4796
	1854.				
Camp west side of the valley of the Jordan, on the base of the mountain	May......6		39.60	182.55	4657

VII.—*Data for profie from Great Salt Lake valley, via the Weber river, to White Clay creek, the preceding profile being in common with this from the latter point eastward.*

Station.	Date.	Hour.	Intermediate distances.	Distance from Smith's Fork.	Altitudes above the sea.
	1854.				
White Clay creek, Camp 4	April......7	Camp		70.50	5692.1
Dry creek, Camp 3	April......6	Camp	16.50	87.00	5419.1
Sheep rock, Weber river	April......6	12.15 p. m	8.50	95.50	5189.5
Ben Simons' creek, Camp 2	April......5	Camp	12.20	107.70	4842
Weber river, below the mountain	April......5	1.45 p. m	7.80	115.50	4424.1

VIII.—*Meteorological Observations and Table of Altitudes and Distances from Great Salt Lake City, Utah Territory, to Fort Reading, in the valley of the Sacramento river, California*—1854.

NOTE.—It is to be noted that in the entries in the column headed "barometric means" the upper entry is for barometer No. 496; the lower for barometer No. 551. The altitudes are entered opposite the heads of the means from which they are deduced.

Locality.	Date.	Hour.	Intermediate distances.	Distances from Great Salt Lake City.	Bar. reading, No. 496.	Attached thermometer, (C.)	Bar. reading, No. 551.	Attached thermometer, (C.)	Air thermometer, (F.)	Corrected barometer, No. 496.	Corrected barometer, No. 551.	Barometric means.	Altitudes.	Meteorological remarks.
	1854.		*Miles.*	*Miles.*	*Mm.*		*Mm.*			*Inches.*	*Inches.*	*Inches.*	*Feet.*	
Left Council House, Great Salt Lake City, at 5 p. m.	May 5	3 p. m.....	....	....	642.3	16.2	644	16.1	65	25.255	25.322	....	4351	Slight fall of rain; wind southwest.
Jourdan ferry, Camp No. 1	5	....	2.45	2.45	....	....	....	....	....	....	....	....	....	
Camp 2, good grass, brackish water..........	6	6 p. m.....	12.98	15.43	643.2	14.9	643.2	14.7	59	25.294	25.294	....	4657	Dark clouds; wind southwest.
	7	Sunrise....	....	....	645.2	3.9	643.2	3.9	39	25.383	25.305	25.338 25.299	....	Cloudy; wind southwest; snow for two hours.
Left camp 2 at 6.50 a. m.														
Camp 3, west side of Tuilla valley............	7	Sundown..	20.59	36.02	645	5	645	5.5	41	25.396	25.393	25.419	4487.5	Squally; wind southwest.
	8	Sunrise....	....	....	646.6	3	647.1	3	34	25.443	25.463	25.428	....	Heavy clouds; wind southwest.
Camp 4, opposite Stansbury's island, Great Salt lake.	8	3 p. m.....	13.70	49.72	654.5	15.5	653	15.5	62	25.731	25.676	....	4238	Light clouds; wind northwest.
	8	Sundown..	....	....	654.8	10	652.3	9.7	48	25.757	25.758	25.730	....	Heavy clouds in the east.
	9	Sunrise....	....	....	653.6	6	651.8	6	38	25.703	25.632	25.688	....	Heavy clouds in south; wind southeast.
Camp 5, west side of Mountain creek, in Lone Rock valley.	9	4 p. m.....	21.45	71.17	648.4	17.9	647.6	17.9	68	25.498	25.467	....	4444.3	Light clouds; wind northwest.
	9	Sundown..	....	....	648.4	10.9	649.5	10.5	49	25.501	25.544	25.501	....	Light clouds in the east; wind south.
Dry creek, coming from the west.............	10	Sunrise....	....	....	648.1	1.9	648.6	2	33	25.506	25.522	25.511	....	Heavy clouds; wind east.
	10	3 p. m.....	10.26	81.43	627.9	17	625.3	17.9	59	24.684	24.578	....	5469.5	Heavy clouds; wind southwest.
Entrance into Cedar Mountain pass	10	4 p. m.....	1.54	82.97	626.8	19	624.7	19.5	64	24.648	24.561	....	5528.4	Light clouds; wind east.
	10	5 p. m.....	....	....	626	16	624.1	19	61	24.633	24.543	....	5576.5	Heavy clouds; wind southwest.
Camp 6, in pass...............................	10	6 p. m.....	3.24	86.21	626.1	16	623.4	16	57	24.617	24.511	24.530	5580.5	Light clouds; wind north.
Camp 6, in pass...............................	11	Sunrise....	....	....	621.3	4	621.5	4	36	24.443	24.451	24.481	....	Heavy clouds; wind southwest.
Summit of Cedar Mountain pass.............	11	9.30 a. m..	2.15	88.36	607.3	11	610.2	10.5	60	23.822	23.936	23.794	6364	Heavy clouds; wind northeast.
	11	10.30 a. m.	....	....	606.5	16	609.3	15	59	23.766	23.887	23.911	....	Light clouds.
First descent of Mountain pass...............	11	11.30 a. m.	.23	88.59	613.3	18.9	614.1	17.3	69	24.031	24.071	24.032	6186	
	11	12.30 p. m.	....	....	612.4	16.5	611.6	16.3	60	24.033	21.001	24.036	....	
Camp 7, west side of Cedar Mountain pass....	11	6.20 p. m..	1.30	89.89	624.5	12	621.7	11.9	52	24.567	24.457	....	5575	Wind northeast; signs of rain.
	11	7.10 p. m..	....	....	623.9	8.5	621	8.5	44	24.546	24.436	24.547	....	Rain; wind southeast.
	12	Sunrise....	....	....	623.7	5.6	622.8	5.3	39	24.530	24.498	24.463	....	Heavy clouds in east; wind north.
Foot of mountain..............................	12	8 a. m.....	2.43	92.32	639.5	9.5	639.9	9	30	25.108	25.128	....	4775.5	Heavy clouds in south; calm.
Camp 8, at Granite mountain*.................	12	6.40 p. m..	17.33	109.65	645.4	15.5	644.6	15	59	25.370	25.338	....	4666.4	Clear; strong southwest wind.
Camp 9, eastern base of Goshoot mountain, at fine spring; grass, but no wood.	13	7.20 p. m..	25.32	134.97	646 5	10.5	642.8	10	52	25.425	25.283	....	4659·5	Cloudy; wind northeast.
	14	6 a. m.....	....	....	646	6.5	645.1	6	41	25.399	25.367	....	....	Do do.
(Not in line of profile)......................	14	12 m.......	....	....	645.2	16.9	643.7	17	69	25.310	25.247	....	....	Clear; wind southwest.
	14	3 p. m.....	....	....	646.1	18	643.6	18.5	69.5	25.393	25.294	25.390	....	Squally; wind southwest.
	14	6.50 p. m..	....	....	646.5	12.5	645.4	12	54	25.424	25.381	25.314	....	Squally; wind northeast.
	15	Sunrise....	....	....	647.9	7.5	648.1	7	41	25.476	25.488	....	....	Cloudy; snow in the night.
Summit of mountain in pass, (not in profile)..	15	2.30 p. m..	13.10	148.07	....	....	609.5	14	59	....	23.961	....	6233.2	Cloudy; in the northwest squally.
Camp 10, Pangwich or Fish creek	15	Sundown..	5.53	153.60	634.3	14.2	632.1	14.5	56	24.930	24.843	....	5076.5	Clear; wind northwest.
Exploring the Goshoot mountains for a pass...	15	9.45 a. m.	....	....	614.2	9.3	....	....	49	24.193	....	....	5903.5	
(Not in profile line.)	15	11.20 a. m.	....	....	605.3	10.9	....	....	57	23.743	....	....	6473.1	
	15	1 p. m.....	....	....	618.4	13.6	....	....	58	24.287	....	....	5852.3	
Fish creek, near Desert line of profile..	15	3.15 p. m..	....	....	635.8	16.6	....	....	62	24.999	....	....	5073.2	From camp at Granite Mt., 39.8 miles across the Desert, and 16.5 miles to camp on Fish creek.
	16	Sunrise....	....	....	635	3	633.9	3	39	24.988	24.944	....	....	Clear; wind east.
Summit of mountain spur....................	16	5 p. m.....	14.13	167.73	611.5	13.5	609.3	13.7	59	24.074	23.987	....	6154.1	Cloudy; wind northeast.

* From this point the profile passes the Goshoot mountains by crossing the Desert to Fish creek, and thence ascending this stream to our camp of the 15th instant—the distances being 39.8 miles to the creek station, and 16.5 miles thence to camp.

VIII.—*Meteorological Observations and Table of Altitudes and Distances from Great Salt Lake City to Fort Reading*—Continued.

Locality.	Date.	Hour.	Intermediate distances.	Distances from Great Salt Lake City.	Bar. reading, No. 496.	Attached thermometer, (C.)	Bar. reading, No. 551.	Attached thermometer, (C.)	Air thermometer, (F.)	Corrected barometer, No. 496.	Corrected barometer, No. 551.	Barometric means.	Altitudes.	Meteorological remarks.
	1854.		*Miles.*	*Miles.*	*Mm.*		*Mm.*			*Inches.*	*Inches.*	*Inches.*	*Feet.*	
Camp 11, in mountain pass	May 16	10 p. m.	7.47	....	611.1	12	610.5	11.9	39	23.962	23.939	....	....	Rain.
Camp 11, in mountain pass	16	10 p. m.	7.47	175.19	611.1	12	610.5	11.9	39	23.962	23.939	23.996	6073.1	Clear and calm.
	17	Sunrise	....	....	610.9	5	609.7	5.7	36	24.031	23.980	23.959	....	Cloudy; wind northwest.
On ascent to divide between 1st and 2d creeks of the pass.	17	8.5 a. m.	1.82	177.01	605	13	605.3	13.5	59	23.738	23.750	....	6485.4	Clear; wind northwest.
	17	9.5 a. m.	1.12	178.13	602.8	16.3	602.4	16.9	67	23.630	23.614	....	6684.2	Do do.
Ascending 2d creek	17	10.5 a. m.	1.25	179.38	602.6	16.9	602.7	17	70	23.612	23.612	....	6717	Do do.
Summit of pass	17	11.5 a. m.	1 93	181.31	695.7	16.9	596.2	17	64	23.335	23.355	....	6992.2	Cloudy in the south; wind northeast.
Camp 12, good grass, wood, and water	17	12.20 p. m.	1.42	182.73	600.4	13.6	601.4	13.6	57	23.566	23.606	....	6550.3	Thunder; wind southeast.
	17	Sundown	....	....	600.6	11.9	599.8	12.3	54	23.619	23.575	23.628	....	Do do.
	18	Sunrise	....	....	602.4	4	601.4	4	32	23.700	23.661	23.614	....	Clear; wind southeast.
Foot of mountain	18	9 a. m.	8.38	191.11	614.6	14 9	616.6	15	60	24.102	24.177	....	6034.4	Clear and calm.
In open valley, Goshoot lake, to the left	18	12 m.	6.86	197.97	618.1	21.6	619.5	21.6	68	24.227	24.282	....	5952.4	Clear; wind northeast.
Camp 13, (spring) grass and willows	18	3 p. m.	3.22	201.19	617.7	22	618.2	22	69	24.263	24.282	....	5859.3	Clear; wind northwest.
	18	Sundown	....	....	617.8	20	616.9	22.6	60	24.260	24.217	24.267	....	Do do.
	19	Sunrise	....	....	617	2.9	616.2	3	32	24.279	24.247	24.248	....	Do do.
Base of hill	19	8 a. m.	3.30	204.49	616	21.5	615.2	21.9	71	24.140	24.108	....	6121.4	Clear; wind northeast.
Top of deep ravine	19	10.30 a. m.	5.07	209.56	605.2	20.6	604.5	20.8	70	23.695	23.668	....	6635.2	Do do.
Passing over a mountain spur, extending into valley.	19	12 m.	1.65	211.21	604.8	25	603.6	24.8	73	23.692	23.645	....	6665.1	Do do.
On a spur of mountain	19	1.15 p. m.	2.57	213.78	602 8	26.3	603.1	26.6	73	23.630	23.642	....	6710.1	Do do.
	19	1.45 p. m.	.54	214.32	601.9	25	602.5	25.9	73	23.612	23.632	....	6726.1	Do do.
Camp 14, good water and grass	19	3.10 p. m.	2.92	217.24	612.6	29.4	611.2	29	73	24.036	23 985	....	6165.1	Do do.
	19	Sundown	....	....	611.8	24.9	610.3	22.9	66	23.976	23.925	24.044	....	Do do.
	20	Sunrise	....	....	613.4	7	612.7	7	39	24.121	24 094	24.001	....	Clear; wind southeast.
Camp 15, Franklin river, in large meadows of grass, on plain east of Humboldt mountains.	20	Sundown	21.52	238.76	614.5	21.5	613.3	21.7	71	24.126	24.075	24.159	6004.2	Clear; wind west.
	21	Sunrise	....	....	615	5	613.6	5	37	24.192	24.137	24.106	....	Clear; wind east.
Camp 16, Franklin river, extensive grass fields.	21	3.30 p. m.	14.84	253.60	614.5	24	612.9	24.5	75	24.136	24.073	....	6061.4	Clear; wind southwest.
	21	7 p. m.	....	....	615.5	24.5	613.8	24.4	69	24.158	24.091	24.142	....	Do do.
	22	Sunrise	....	....	613.6	5.9	613.8	6	39	24.133	24.141	24.101	....	Clear; wind northeast.
Crossing a mountain stream	22	10.30 a. m.	7.65	261.25	608.8	26.3	609.1	26.6	76	23.814	23.835	....	6506.3	Clear; wind northwest.
Foot of pass, in Humboldt mountains	22	1.30 p. m.	....	263.30	607.9	21.9	608 7	22	73	23.856	23.863	....	6433.1	Not in line of profile.
Summit of pass	22	2 p. m.	2.89	264.14	604.5	21.9	605.3	22	73	23.732	23.760	....	6579.1	Cloudy; wind southwest.
On stream, western slope of pass	22	3 p. m.	.80	264.94	606.3	24.9	607.5	25	78	23 806	23.849	....	6516.4	Do do.
Camp 17, good grass and water. Not in line of profile.	22	7.20 p. m.	....	265.56	607.6	16	608 4	16.8	59	23.874	23.905	23.862	6274.2	Squally; heavy clouds.
	23	Sunrise	....	....	606.8	8.9	607.5	9	42	23.854	23.881	23.893	....	Clear; wind northwest.
Camp 18. Not in line of profile	23	3.20 p. m.	....	264.85	....	....	605.8	24	77	....	23.791	23.761	6520.2	Heavy clouds; thunder.
	23	7 p. m.	....	....	604.4	14.5	605.5	14.9	63	23.761	23.800	23.795	....	Rain and thunder.
On creek, valley of Humboldt river*	23	12 m.	....	....	626.4	25.7	....	....	82	24.534	....	....	....	Cloudy.
	23	1 p. m.	8.36	273.21	625.3	26.4	....	....	86	24.511	....	....	5770.4	Do.
	23	1.30 p. m.	....	....	623 4	23.2	....	....	75	24.458	....	....	....	Mean of last 3 observations.
	23	2 p. m.	....	....	623	24	....	....	78	24.449	....	24.472	....	Do do.
Camp 18, east of Camp 17	24	Sunrise	....	....	602.6	9	604.3	9.3	44	23.688	23.755	....	....	Cloudy; wind northwest.
On mountain spur, eastern base of Humboldt mountain.	24	10.20 a. m.	6.25	271	597.1	19	598.2	19.5	67	23.383	23.422	....	6946.1	Clear and calm.
Crossing mountain stream	24	1 p. m.	4.50	275.50	605.9	22.9	606.2	23	73	23.763	23.854	....	6505.1	Cloudy; wind northwest.
Camp 19, near forty hot springs	24	Sundown	8.45	284.06	606	11.5	606.9	11.9	52	23.830	23.826	23.848	6288.2	Heavy rain from 4 to 7 p. m.
	25	Sunrise	....	....	607.5	13	608.6	13.5	56.3	23.866	23.909	23.885	....	Cloudy; heavy rain all day.
Camp 20	26	....	7.97	292.03	....	....	....	....	....	....	....	....	....	
Camp 21, wood, water, and grass	27	7.10 p. m.	13.91	305.94	608.3	16.3	607.7	16	60	23.904	23.881	23.910	6245.2	Cloudy; wind southwest.
	28	Sunrise	....	....	608.1	6.3	607.9	6	41	23.917	23.909	23.895	....	Cloudy; wind northwest.
At base of pass of Humboldt mountains	28	2 p. m.	22.07	328.01	604 9	11.5	603.4	11.5	52	23.785	23.726	....	6425.2	Strong wind from northwest.
On summit of pass in Humboldt mountains	28	4 p. m.	3.11	331.12	592.3	9	594.6	9	49	23.329	23.419	....	6848.4	Strong wind from northwest.
Camp 22, south branch of Humboldt river	29	Sunrise	9.93	341.05	616.1	0	615.4	0	26	24.255	24.228	....	5706.4	Clear; snow in mountains.
Base of hill	29	10.20 a. m.	1.55	342.60	617.6	6.2	615.8	6.4	39	24.240	24.169	....	5828.5	Clear; wind northwest.

Foot of cañon		29	12 m	3.83	346.43	616.6	7	618.6	6.9	47	24.223	24.302	....	5813.1	Do do.
Summit of cañon		29	1 p. m.	1.45	347.88	614.1	11	614.8	10.9	49	24.129	24.157	....	5960.4	Do do.
Camp 23, South fork of the Humboldt		29	Sundown	9.19	357.07	609.3	4.5	611.1	4.9	39	23.986	24.053	23.935	6066.2	Do do.
		30	Sunrise	....	....	607	2.9	608.9	3	31	23.885	23.960	24.006	....	Do do.
On summit of spur		30	9 a. m.	1.95	359.02	599.8	11	602.1	10.9	51	23.531	23.622	....	6627	Do do.
Descent from ditto		30	10 a. m.	2.40	361.42	606.3	9	607	9.5	52	23.785	23.813	....	6374.3	Do do.
Descent base of hill on left		30	11 a. m.	2.37	363.79	608.2	10	610	10.5	54	23.851	23.922	....	6288	Cloudy; hail; wind northwest.
Top of mountain		30	1 p. m.	1.45	365.24	604	13	606.9	14	54	23.724	23.834	....	6411	Cloudy; wind northwest.
At stream at base of mountain		30	3 p. m.	1.26	366.50	620.9	14	622.4	14.4	60	24.420	24.479	....	5681	Do do.
Camp 24, on bank of stream		30	Sundown	1.11	367.61	625	17.5	626.8	16.9	49	24.553	24.624	24.567	5368.1	Clear; wind northwest.
		31	Sunrise	....	....	624.4	0	626.2	−0.5	23	24.582	24.653	24.638	....	Do do.
West side of stream		31	9 a. m.	5.79	373.40	625.5	16.3	624.7	16.5	74	24.523	24.492	....	5693.3	Do do.
Ascending		31	11 a. m.	5	378.40	615.5	20	616.3	20	72	24.099	24.130	....	6139.4	Cloudy; wind southeast.
On a summit		31	2.45 p. m.	4.67	383.07	612.2	18.9	611.1	18.6	66	24.054	24.011	....	6197	Cloudy; wind southwest.
On stream		31	....	4.28	387.35	611.6	16	610.8	16.6	60	24.064	24.033	....	6140.2	Do do.
Camp 25, creek, sage and grass		31	Sundown	2.20	389.55	609.5	13.9	610.3	14	52	23.954	24.025	23.945	6150.2	Cloudy; wind northwest.
	June	1	Sunrise	....	....	608.8	7.9	609.9	8	45	23.936	23.980	24.002	....	Clear; wind northwest.
Confluence of streams, base of pass		1	8 a. m.	2.15	391.70	603.6	13.5	605	13.5	59	23.683	23.738	....	6526.1	Do do.
Ascent of mountain		1	10.30 a. m.	2.50	394.20	583.9	12.5	586.2	12.9	51	22.888	22.979	....	7387.3	Do do.
Summit of Quartz mountain		1	11.30 a. m.	.64	394.84	580.1	14.9	581.9	15.6	56	22.744	22.810	....	7615.1	Cloudy; wind northwest.
First descent on stream		1	12 m	.82	395.66	597.8	13.7	599.3	14	56	23.460	23.515	....	6766.3	Do do.
Camp 26, in Agate Pass		1	7 p. m.	.72	396.38	606.2	9	608	9.4	46	23.851	23.922	....	6227	Do do.
		2	Sunrise	....	....	606.8	5	608.6	5.5	37	23.870	23.940	23.851	....	Hail and snow.
		2	12 30 p. m.	....	....	606.7	10.4	606.7	11	45	23.832	23.828	23.896	....	Clear.
Camp 27, foot of Agate Pass		2	Sundown	2.65	399.03	635.1	9	635.9	9	48	24.982	25.013	24.977	5006.5	Rain; wind southwest.
		3	Sunrise	....	....	635.2	8.5	635.4	8	46	24.972	24.984	24.998	....	Cloudy; wind south.
		3	8.10 a. m.	2.56	401.59	642.5	17	642.6	17	59	25.193	25.197	....	4840.5	Clear; wind southeast.
Base of hill		3	11.30 a. m.	7.34	408.93	640.9	18	640.7	18.5	57	25.118	25.110	....	4919.5	Rain; wind northwest.
Divide of streams		3	2 p. m.	3.30	412.23	631.8	18.6	631.3	18.9	68	24.815	24.795	....	5323.3	Clear; wind southwest.
Base of hill, in valley		3	2.30 p. m.	.58	412.81	632.3	19	634.2	19.5	68	24.842	24.913	....	5241.5	Do do.
Pass between buttes		3	3.40 p. m.	3.52	416.33	626.3	15.8	627.5	15	60	24.635	24.686	....	5442.2	Cloudy; wind southwest.
On summit		3	4.20 p. m.	.73	417.06	625.7	12.9	627.3	13	54	24.630	24.693	....	5441.4	Rain; wind southwest.
Camp 28, west side of creek		3	Sundown	.56	417.62	627.7	13.2	628.6	13.9	51	24.675	24.706	24.670	5296.3	Clear; wind northeast.
		4	Sunrise	....	....	627.1	5.6	628.9	5	32	24.665	24.739	24.722	....	Clear; wind northwest.
In ravine, on stream		4	10 a. m.	3.08	420.70	621.7	18.9	622.4	19	69	24.352	24.380	....	5829.1	Clear; wind northeast.
In ravine, on stream, base of hill		4	11.20 a. m.	2.39	423.09	609.4	21.9	608.2	22	78	23.865	23.814	....	6502.2	Clear; wind northwest.
On ascent of mountain		4	12 m	.77	423.86	600.9	21.9	602.9	22.3	70	23.550	23.625	....	6747.2	Do do.
Top of pass		4	2 p. m.	2.19	426.05	587.3	18.9	589.4	19	69	23.067	23.150	....	7315.2	Do do.
On stream, running from pass		4	2.40 p. m.	.50	426.55	603.7	22	605	22.5	72	23.710	23.758	....	6470	Do do.
Camp 29, end of stream		4	Sundown	2.44	428.99	622.3	18	622	18.3	55	24.453	24.431	24.433	5648.5	Do do.
		5	Sunrise	....	....	621.2	11.5	621.7	11	48	24.413	24.433	24.432	....	Clear; wind northeast.
Base of small hill		5	8.50 a. m.	2.60	431.59	632.9	19.2	633.5	19.5	67	24.805	24.825	....	5306.3	Clear and calm.
In valley		5	10 a. m.	1.84	433.43	639.4	21.8	641.3	22	69	25.037	25.108	....	5029.4	Clear; wind west.
In valley, base of hill on the left		5	12 m	8.27	441.70	642.8	28.5	644.4	29	82	25.168	25.227	....	4955.6	Clear; wind southwest.
On rise in valley		5	1 p. m.	3.90	445.60	642.4	28.8	643.8	29	86	25.172	25.224	....	4974.5	Do do.
Camp 30, fine mountain stream, good grass		5	10 p. m.	13.49	459.09	633.9	20.3	624.9	20.9	62	24.485	24.520	24.498	5601.1	Do do.
		6	5.30 a. m.	....	....	624.1	13.8	624.9	14	56	24.511	24.543	24.531	....	Do do.
Base of hill		6	8 a. m.	.72	459.81	629.6	18.9	628.9	18	66	24.683	24.659	....	5463.4	Clear; wind northeast.
Top of hill		6	9 a. m.	2	461.81	622	20.7	621.9	20.4	70	24.366	24.366	....	5835.1	Do do.
In pass		6	11 a. m.	3.54	465.35	622.7	24.6	621.2	24.4	71	24.363	24.308	....	5877.2	Do do.
On ascent		6	1.30 p. m.	4.43	469.78	631.5	26	630.1	26	75	24.765	24.710	....	5439.3	Do do.
Camp 31, on west side of stream		6	Sundown	3.43	473.21	631.2	12.2	630.3	12	54	24.817	24.781	24.806	5249	Rain and thunder; wind northeast.
		7	Sunrise	....	....	630.6	7.7	629.1	7.7	46	24.795	24.735	24.758	....	Cloudy; wind west
In pass, at base of hill		7	8 a. m.	1.25	474.46	628.3	9.9	628	10.4	50	24.727	24.715	....	5316.6	Do do.
Descending in pass		7	9.15 a. m.	2.76	477.22	629	13.9	630	14	58	24.667	24.706	....	5400.6	Do do.
Mouth of ravine, in valley		7	10.30 a. m.	3.74	480.96	642.9	17	643.1	17.4	62	25.188	25.196	....	4859.6	Cloudy; wind northwest.
Entering pass		7	1.30 p. m.	7.19	488.15	641.8	18.9	640.8	19	66	25.198	25.155	....	4898.1	Do do.
In ravine or pass		7	3.50 p. m.	4.64	492.79	632.1	19.3	631	19	67	24.853	24.810	....	5288.3	Clear; wind northwest.
Camp 32, water and grass		7	Sundown	.99	493.78	628	10.5	629	10	50	24.698	24.738	24.734	5259.1	Do do.
		8	Sunrise	....	....	629.7	5	629.6	5	38	24.771	24.767	24.752	....	Clear; wind southwest.
Summit of pass		8	7.30 a. m.	2.25	496.03	614.2	17.3	612.8	17	61	24.090	24.035	....	6129.2	Clear; wind northwest.
Crossing stream		8	9.30 a. m.	3.73	499.76	651.5	19.5	650.3	19.8	70	25.522	25.475	....	4561.3	Do do.
In valley		8	3.30 p. m.	16.15	515.91	651.4	21.8	650.2	22	72	25.593	25.545	....	4493	Do do.
On a small spur of mountain		8	4.30 p. m.	2.73	578.64	646.8	20.5	646.4	20.9	75	25.430	25.411	....	4686.3	Clear; wind west.
Base of mountain		8	5.30 p. m.	2	520.64	652.2	21.3	....	....	71	25.627	....	....	4424.3	Do do.
Camp 33, east bank of Humboldt river.†		8	Sundown	3.40	524.04	656.7	20.3	656.3	20.3	69	25.781	25.765	25.831	4140.9	Cloudy; wind west.
		9	Sunrise	....	....	658.9	13.3	659.4	11	47	25.881	25.913	25.839	....	Cloudy, wind east.
Camp 34, Humboldt river crossing		9	Sundown	6.80	530.84	658.7	19.8	....	....	68.3	25.860	....	25.859	4147	Clear and calm.
		10	Sunrise	....	....	658.4	14.6	657.6	14	54	25.858	25.826	25.826	....	Do do.

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* From this point (in the open valley of Humboldt river) the proposed line for a railroad descends Humboldt river to the vicinity of our camp of June 8. The line explored to the south of this is given in profile by itself, from data in this table from May 24 to June 8.

† At this point we return to the proposed line for a railroad, descending the valley of Humboldt river.

VIII.—*Meteorological Observations and Table of Altitudes and Distances from Great Salt Lake City to Fort Reading*—Continued.

Locality.	Date.	Hour.	Intermediate distances.	Distances from Great Salt Lake City.	Bar. reading, No. 496.	Attached thermometer, (C.)	Bar. reading, No. 551.	Attached thermometer, (C.)	Air thermometer, (F.)	Corrected barometer, No. 496.	Corrected barometer, No. 551.	Barometric means.	Altitudes.	Meteorological remarks.
	1854.		*Miles.*	*Miles.*	*Mm.*		*Mm.*			*Inches.*	*Inches.*	*Inches.*	*Feet.*	
Camp 35, on California road, at Lassen's meadows.	June 10	Sundown..	3.51	534.35	658.8	21.5	657.7	21.9	70	25.856	25.813	25.859	4152.2	Cloudy; wind northeast.
	11	Sunrise....	....	....	658.4	13.5	657.5	14	53	25.862	25.826	25.819	....	Cloudy; wind northwest.
Foot-hills, above H. river....................	11	10 a. m....	9.64	543.99	658.3	24	657.7	25.9	75	25.765	25.734	....	4309	Cloudy; wind northwest.
In bed of dry creek..........................	11	2.30 p. m..	7.86	551.85	653	28.9	653.4	29	84	25.614	25 626	....	4492	Cloudy; wind southwest.
	11	5.30 p. m..	6.93	558.78	641.2	22.8	640.4	22.8	74	25.194	25.158	....	4938.7	Do do.
Camp 36, not on line of profile................	12	Sunrise....	5.13	563.91	615.4	12.6	616.2	12.9	55	24.177	24.208	....	....	Do do.
Summit of pass, profile distance 5.50 miles....	12	9 a. m.....	1.95	565.86	629.4	18.9	629.3	18.7	66	24.665	24.661	....	5173.2	Do do.
Descending from pass..........................	12	1.20 p. m..	10.55	576.41	649	19	649.7	19	65	25.473	25.496	....	4553.1	Do do.
Descending from pass, not on line of profile....	12	2 p. m.....	....	....	648.4	18.9	648	18.9	64	25.464	25.448	....	4579.2	Do do.
Junction of dry creeks, on descent............	12	3.30 p. m..	4.68	581.09	652.4	19.3	651.6	20	65	25.641	25.613	....	4410.5	Strong northwest wind.
Bed of dry creek..............................	12	4.15 p. m..	1.85	582.94	654.7	18.7	654.5	19	64	25.739	25.731	....	4275	Do do.
In valley.....................................	12	5.13 p. m..	2.55	585.49	654.3	17	653.9	17.8	60	25.734	25.711	....	4278.2	Cloudy; northwest wind.
Camp 37. This height not used in profile.....	13	5.30 a. m..	7.17	592.66	647.2	10	646.7	10.6	49	25.436	25.413	....	4544	Rain; wind northwest.
Dry creek, in valley. Distance from second preceding station, line of profile, 8.17 miles.	13	9 a. m.....	3.17	595.83	650.8	12	650.5	12.2	53	25.531	25.519	....	4451.5	Do do.
On stream, in cañon..........................	13	10 a. m....	1.95	597.78	648.5	16	649.3	16	59	25.415	25.446	....	4583.3	Do do.
Summit.......................................	13	10.50 a. m.	1.37	599.15	642.3	16	642.3	16	57	25.171	25.167	....	4866.2	Cloudy; wind northwest
Descending into valley........................	13	12.30 p. m.	2.55	601.70	644.6	16	644.2	16	64	25.296	25.281	....	4763.4	Do do.
Passing small hills in valley..................	13	4 p. m.....	7.04	608.74	635.5	17	635.5	17.6	62	24.998	24.994	....	5076.2	Do do.
Passing small hills, on direct line to Mud lake, by an open passage north.	13	5 p. m.....	2.54	611.28	635.7	14.5	635.8	14.5	59	25.019	25.023	....	5033	Rain; wind northwest.
			11.75	....	....	....	....	....	....	....	....	....	4134	
* Camp 38, grass, but no water................	14	Sunrise....	5.50	616.78	632.6	11.6	632.9	11.8	50	24.468	24.869	....	5376.2	Do do.
* Summit.....................................	14	8.40 a. m..	2.20	618.98	627.9	17.9	627.5	19	60	24.617	24.597	....	5501.1	Clear; wind northwest.
* In pass.....................................	14	9.30 a. m..	1.65	620.63	637.6	20.3	636.4	21	63	24.975	24.534	....	5353	Do do.
Valley of Mud lake, point of mountain. Distance, by line of profile, 15.39 miles.	14	5 p. m.....	11.54	632.17	659	21	658.8	21	69	25.872	25.860	....	4134	Do do.
Camp 39, east base of Sierra Nevada..........	15	Sunrise....	9.88	642.05	659.2	15.3	658.9	15	54	25.886	25.873	25.874	4118.1	Clear; wind west.
	15	Sundown..	....	....	658.9	21.7	659.3	21.9	71	25.860	25.876	25.874	....	Do do.
	16	Sunrise....	....	....	660.2	15	660.3	15	58	25.929	25.933	....	....	Cloudy; wind west.
At point of mountain..........................	16	8 a. m.....	3	645.05	661.4	20	661.4	21	65	25.923	25.919	....	4079	Clear and calm.
Foot of Madelin Pass, Smoky creek...........	21	1 p. m.....	16	661.05	657	29.5	....	....	86	25.740	....	....	4370	Light clouds; high wind.
	21	12 m.......	....	....	656.9	27.5	....	....	82	25.720	....	....	....	Do do.
Smoky creek, head of small cañon...........	21	11 a. m....	3	664.05	654.3	31	....	....	74	25.575	....	....	4495.2	Do do.
Smoky creek, ascending pass..................	21	10 a. m....	3	667.05	649	27	....	....	70	25.391	....	....	4679.5	Do do.
	21	9 a. m.....	2.50	669.55	646	28.6	....	....	74	25.275	....	....	4827.3	Do do.
	21	8 a. m.....	2.50	672.05	640.6	24.4	....	....	70.5	25.092	....	....	5014.6	Do do.
Madelin Pass, camp 44; wood, water, and grass. This altitude not in line of profile.	22	Sunrise ...	2	674.05	639.4	2.9	639.7	3	32	25.161	25.173	....	4914.5	Clear; wind northwest.
	21	Sundown...	....	....	639	16	638.2	16.9	56.5	25.108	25.072	....	....	Wind all day.
	21	Sunrise....	....	....	637.9	9	637.9	9	41	25.078	25.078	....	....	Cloudy in southwest.
	20	Sundown...	....	....	640	22.5	640.4	22.5	72	25.120	25.135	....	....	Clear; wind southwest.
	20	3 p. m.....	....	....	641	28	641.4	28	78	25.152	25.168	25.125	....	Strong south wind.
	20	12 m.......	....	....	642	26	641.5	26	72	25 145	25.125	25.227	....	Strong northwest wind.

IX.—*Meteorological Observations and Table of Altitudes from Mud lake, via Mud creek, to the summit of the Sierra Nevada and Madelin Pass.*†

Mouth of ravine..............................	June 16	12 m......	8.85	653.90	652.8	25	652.2	25	73	25.570	25.550	....	4507.4	Clear; wind west.
Summit of hill................................	16	1 p. m.....	1.47	655.37	643.7	23.3	643.4	23.3	72	25.244	25.232	....	4858.6	Clear; wind northwest.
Camp 40, on Mud creek........................	16	Sundown..	1.88	657.25	654.9	20.8	655	21	69	25.706	25.714	25.711	4275.4	Do do.
	17	Sunrise. ..	....	....	654.2	9	653.5	9	45	25.716	25.688	25.701	....	Cloudy; wind northwest.
In cañon......................................	17	8.20 a. m..	.49	657.74	655.4	18.8	653.1	18.6	67	25.692	25.601	....	4385.5	Cloudy; calm.

	17	9.50 a. m.	.46	658.20	653.4	21.8	651.4	22	73	25.582	25.508	....	4523.5	Cloudy; wind south.
In cañon. (Branches at this point)	17	10.30 a. m.	1.30	659.50	652.2	21.5	650.7	21.9	72	25.534	25.471	....	4566.7	Cloudy; wind southwest.
In cañon	17	11.25 a. m.	1.53	661.03	651.7	18.9	650.1	19.4	63	25.535	25.476	....	....	Do do.
Camp 41, Mud creek, water, grass, and wood.	17	Sundown	....	....	649.3	11.8	649.8	12	51	25.525	25.545	25.558	4406.5	Rain all night; wind south.
	18	Sunrise	....	....	651	11.5	650.3	11.5	49	25.582	25.555	25.550	....	Cloudy; wind south.
Top of 1st terrace	18	10 a. m.	2.05	663.08	638.7	13	639.5	13.3	55	25.045	25.076	....	4969.1	Cloudy; wind northeast.
Junction of streams in cañon	18	12.30 p. m.	1.96	665.04	633.8	19	633.6	19.5	65	24.863	24 855	....	5245.6	Do do.
In cañon	18	1.40 p. m.	2.17	667.21	627.7	20	627.3	20.7	64	24.643	24 624	....	5495.6	Do do.
End of cañon	18	2.50 p. m.	1.82	669.03	619.6	20.9	618.9	19.5	64	24.338	24.319	....	5843.2	Clear; wind southwest.
	18	3.8 p. m.	.23	669.26	620.5	17.3	619	17.6	62	24.393	24.330	....	5792	Do do.
Descent	18	4.8 p. m.	1.60	670.86	621.4	18.2	621.9	18.5	67	24.439	24.459	....	5722.2	Do do.
Camp 42, wood, water, and grass	18	Sundown	.35	671.21	619.1	13	61 .6	13	53	24.336	24.356	24.372	5668.3	Clear; wind west.
	19	Sunrise	....	....	620.3	5	620.4	5	34	24.401	24.405	24.367	....	Clear; wind southwest.
	19	6 a. m.	....	....	620.4	10	619.4	9.8	42	24.379	24.340	....	....	Do do.
Descent	19	10 a. m.	4.30	675.51	....	....	622	16.5	56.5	....	24.376	....	5742	Do do.
	19	12 m.	2.53	678.04	....	....	614.9	16	59	....	24.121	....	6049	Do do.
Descending into Madelin Pass	19	1 p. m.	.64	678.68	....	....	617.7	19.7	67	....	24.239	....	5963.6	Do do.
Madelin Pass, camp 43, wood, water, and grass.	19	4.30 p. m.	1.83	680.51	....	....	631.9	24	73.6	....	24.832	....	5337	Do do.
	19	Sundown	....	....	630.2	21.2	629.3	22.4	69	24.742	24.702	24.760	....	Do do.
	20	Sunrise	....	....	630.3	9	629.4	8.8	41	24.779	24.743	24.759	....	Cloudy; wind east.

VIII.—*Meteorological Observations and Table of Altitudes and Distances from Great Salt lake, Utah Territory, to the valley of the Sacramento river, California*—1854. ‡

Ascent of Sierra Nevada	June 22	8 a. m.	1.56	675.61	637.5	16	637	16.5	55	25.006	24.986	....	5045.3	
In broad valley	22	9 a. m.	1.55	677.16	636.2	19.3	636.3	19.8	65	24.933	24.933	....	5163.5	
	22	10 a. m.	1.56	678.72	634.2	20	633.4	20	65	24.840	24.809	....	5285.6	
	22	11 a. m.	1.55	680.27	631	20.2	630.6	20.5	66	24.709	24.689	....	5432.1	Light clouds; high wind.
	22	12 m.	1.56	681.83	628.8	21.5	628.3	21.3	68	24.649	24.629	....	5511.5	Do do.
Ascent	22	12.50 p. m.	1.32	683.15	626.1	22	625	22	70	24.555	24.512	....	5643.5	Do do.
Summit of Madelin Pass	22	1.20 p. m.	.79	683.94	626.7	22	622.9	22	70	24.587	24.437	....	5667.5	Do do.
On broad summit of Sierra Nevada	22	2.20 p. m.	2	685.94	625.5	22.6	625.3	22.4	70	24.556	24.552	....	5620	Do do.
	22	3.20 p. m.	1.98	687.92	627	23.8	626	24	69.5	24.626	24.587	....	5557	Do do.
	22	4 p. m.	1.94	689.86	629.1	21.9	628.7	22	69	24.726	24.711	....	5427.5	Do do.
On broad summit; not used in profile	22	5.20 p. m.	2.14	692	627.3	21.3	626.5	21	68	24.658	24.626	....	5507.5	Do do.
Camp 45, water, wood, and grass.‖ (Distance from preceding profile station, 3.85 miles.)	22	Sundown	1.71	693.71	629.2	13.9	628	14	54	24.730	24.683	24.736	5250.5	Clear; wind northwest.
	23	Sunrise	....	....	628.2	—3	628.6	—3	25	24.743	24.759	24.721	....	Clear; wind southwest.
Broad plain of the Sierra Nevada	23	10 a. m.	6.03	699.74	....	....	630.6	21.4	64.5	....	24.694	....	5430	Do do.
	23	11.40 a. m.	3.48	703.22	....	....	631 3	21.5	71.5	....	24.737	....	5420.2	Do do.
East from camp of June 23 and 24	23	10.30 a. m.	2.25	....	628.3	20.6	....	....	64	24.562	....	....	5576.2	Not used in any section.
	23	12 m.	2.25	....	631.6	23.8	....	....	72	24.747	....	....	5411.3	
	23	1 p. m.	1	....	634.4	23.2	....	....	73	24.881	....	....	5265.4	
	23	2 p. m.	1	....	640 4	26.5	....	....	77	25.122	....	....	5015.3	
Camp 46, summit of Sierra Nevada	23	Sundown	.86	704.08	630.4	22	629.3	21.2	62	24.746	24.706	24.707	5326.3	Clear; wind southwest.
	24	Sunrise	....	....	627.2	6.2	627.3	6.3	32	24.669	24.673	24.689	....	Cloudy in southeast; wind southwest.
Crossing summit of Sierra Nevada	24	12 m.	13.26	717.34	628.1	23.5	627.8	23.7	72	24.593	24.577	....	5596.4	Light clouds in southwest.
Camp 47, grass, water, and wood§	24	Sundown	6.27	723.61	628.7	11	627.1	11	48	24.722	24.659	24.750	5239.1	Light clouds; wind southwest.
	25	Sunrise	....	....	629.6	2.5	629.3	2.3	28	24.779	24.767	24.713	....	Cloudy; wind southwest.
Water-course	25	12 m.	10.57	734 18	624.8	15.4	624.9	15.6	57	24.515	24.515	....	5585.5	Clear; wind southwest.
On divide, in pass	25	1 p. m.	1.63	735.81	621.1	14.7	620.9	14.9	57	24.389	24.381	....	5736	Clear; wind northwest.
Stream west of summit of the Sierra Nevada.	25	2.30 p. m.	2.42	738.23	630.9	17.9	630.8	17.6	63	24.790	24.786	....	5315.6	Do do.
	25	3.40 p. m.	1.73	739.96	632.9	16.9	632.3	17.3	62	24.891	24.867	....	5207.5	Do do.
On spur. Not in line of profile	25	5 p. m.	....	....	623.9	14.3	625	14.9	58	24.558	24.598	....	5523.2	Do do.
Base of hill in valley	25	6.10 p. m.	3.20	743.16	639.1	15.9	639.1	16	62	25.127	25.127	....	4932.2	Do do.
Camp 48, fine grass. Not used in profile	25	Sundown	2.14	745.30	646.3	10.2	645.8	10.5	48	25.415	25.395	25.435	4468.4	Do do.
	26	Sunrise	....	....	646.4	—2	645.7	—2	19	25.456	25.429	25.412	....	Clear; wind north.
On the waters of the Sacramento river. Distance from preceding profile station 3.67 miles.	26	7.50 a. m.	1	746.30	648.7	7.9	647.7	7.9	42	25.476	25.441	....	4472	Clear; wind northwest.
East of stream in Round valley	26	9 a. m.	2.25	748.55	651.2	9.8	650.9	10.7	50	25.555	25.539	....	4415.7	Do do.
On stream at base of hill, Round valley	26	10 a. m.	2.08	750.63	652.8	11.4	651.7	11 7	53	25.600	25.557	....	4395	Do do.
Leaving creek	26	11.30 a. m.	1.25	751.88	654.2	13.4	654.6	13.6	53	25.661	25.673	....	4299.2	Do do.

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* Not used in profile.

† This table is not used in profile.

‡ Line of profile resumed.

‖ From this point to the camp of June 24, 25, the line of profile is direct and the grade uniform, the distance being 21.9 miles.

§ From this point back to the camp of June 22, the line of profile is direct and the grade uniform.

VIII.—*Meteorological Observations and Table of Altitudes and Distances from Great Salt lake to Sacramento valley*—Continued.

Locality.	Date.	Hour.	Intermediate distances.	Distances from Great Salt Lake City.	Bar. reading, No. 496.	Attached thermometer, (C.)	Bar. reading, No. 551.	Attached thermometer. (C.)	Air thermometer, (F.)	Corrected barometer, No. 496.	Corrected barometer, No. 551.	Barometric means.	Altitudes.	Meteorological remarks.
	1854.		*Miles.*	*Miles.*	*Mm.*		*Mm.*			*Inches.*	*Inches.*	*Inches.*	*Feet.*	
Round valley. Not used in profile..........	June 26	3 p. m.....	7.78	759.66	656.8	18	657.4	18	63	25.810	25.838	....	4174.8	Clear; wind northwest.
Camp 49, west side of stream. Distance from last profile station, 8.8 miles.	26	Sundown..	1.03	760.69	657.9	16.2	656.7	16.3	69	25.844	25.797	25.843	4127.4	Do do.
	27	Sunrise....	....	....	656.9	4	656.8	4	38	25.842	25.838	25.817	....	Clear; wind northeast.
Foot of Round valley, and head of first cañon of the Sacramento or Pitt river.	27	9 a. m.....	4.76	765.45	658.9	16	657.9	16.2	55	25.831	25.791	....	4153.7	Do do.

X.—*Meteorological Observations and Table of Altitudes in crossing from Madelin to Noble's Pass, summit of the Sierra Nevada.**

Locality.	Date.	Hour.	Intermediate distances.	Distances from foot of Round vale.	Bar. reading, No. 496.	Attached thermometer, (C.)	Bar. reading, No. 551.	Attached thermometer, (C.)	Air thermometer, (F.)	Corrected barometer, No. 496.	Corrected barometer, No. 551.	Barometric means.	Altitudes.	Meteorological remarks.
			Miles.	*Miles.*	*Mm.*		*Mm.*			*Inches.*	*Inches.*	*Inches.*	*Feet.*	
Camp 50, near the first cañon of the Sacramento.	June 27	Sundown..	4.58	....	652.2	19.4	651.7	19	62	25.612	25.588	....	4467.4	Cloudy; wind west.
	28	Sunrise....	....	....	652.7	9	651.6	9	43	25.657	25.613	....	....	Cloudy; wind southeast.
	28	Sundown..	....	....	....	....	651.5	21	74.5	....	25.572	....	....	Clear; wind northwest.
	29	Sunrise....	....	....	....	....	651	9	47	....	25.594	....	....	Cloudy; wind southeast.
	29	12.20 p. m.	....	....	....	....	651.2	22.5	72.5	....	25.526	....	....	Light clouds; wind southwest.
	29	4 p. m.....	....	....	....	....	650.1	24.2	76.3	....	25.541	25.561	....	Do do.
	29	Sundown..	....	....	648.9	20.4	649	20.7	69	25.474	25.478	25.543	....	Cloudy in west; wind southeast.
	30	Sunrise....	....	....	647.7	9	647	9.3	47	25.460	25.432	....	....	Cloudy; wind southeast.
Summit, returning to eastern base of Sierra Nevada.	30	8.15 a. m..	2.25	6.83	632.9	13.9	633.7	13.6	53	24.831	24.862	....	5195.2	Light clouds; wind southwest.
On terrace..................................	30	2 p. m.....	10.17	17	632.2	19.3	631.4	19.6	67	24.830	24.795	....	5310.2	Light clouds; wind northwest.
Summit......................................	30	3 p. m.....	1.53	18.53	633	21.3	632.5	21.7	66	24.869	24.845	....	5253.6	Do do.
Camp 51, wood, water, and grass............	30	Sundown..	1.59	20.12	641	16.4	639	16.6	62	25.183	25.104	25.191	4841.5	Do do.
	July 1	Sunrise....	....	....	640.5	4	638.7	4.3	38	25.200	25.129	25.116	....	Clear; wind southwest.
Ascent......................................	1	9.40 a. m..	5.04	25.16	622.3	17.7	622.7	17.3	62	24.383	24.402	....	5758	Do do.
	1	12 m.......	4.68	29.84	615.1	18.8	615.5	18.8	65	24.117	24.133	....	6083.2	Clear; wind northwest.
On divide...................................	1	2.20 p. m..	5.68	35.52	610	24	608.7	24.3	68	23.942	23.891	....	6346	Do do.
Camp 52.....................................	1	Sundown..	3.43	38.95	621.1	14.3	619	14.5	56	24.411	24.328	24.441	5492.4	Do do.
	2	Sunrise....	....	....	621.6	0	620	—0.2	28	24.472	24.421	24.374	....	Clear; wind northeast.
On a terrace, plain of Sierra Nevada.........	2	8.40 a. m...	4.25	43.20	621.1	17.5	621.1	15.6	57	24.349	24.357	....	5771.1	Light clouds; wind southwest.
Pine creek..................................	2	11 a. m....	6.25	49.45	....	....	....	....	....	....	....	....	....	

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* This table is not used in profile.

VIII.—*Meteorological Observations and Table of Altitudes and Distances from Great Salt lake, Utah Territory, to the valley of the Sacramento river, California*—1854.*

Locality.	Date.	Hour.	Intermediate distance.	Distance from Great Salt Lake City.	Bar. reading, No. 496.	Attached thermometer, (C.)	Bar. reading, No. 551.	Attached thermometer, (C.)	Air thermometer, (F.)	Corrected barometer, No. 496.	Corrected barometer, No. 551.	Barometric means.	Altitudes.	Meteorological remarks.
	1854.		*Miles.*	*Miles.*	*Mm.*		*Mm.*			*Inches.*	*Inches.*	*Inches.*	*Feet.*	
Foot of first cañon of Sacramento river*	June 29	11 a. m.	13.74	779.19	675.3	30	...	...	80	26.402	...	...	3622.4	Clear.
Mouth of Fall river, and head of second cañon.	29	6.30 a. m.	13.50	792.69	677.9	8	...	...	46	26.636	...	26.661	3249.9	Clear; wind northwest.
	29	Sunrise	...	...	678	5.5	...	...	32	26.669	...	...	...	Do do.
	28	Sundown	...	...	679.3	18.2	...	...	59	26.679	...	...	...	Do do.
Sacramento river, and mouth of second cañon.	July 21	2.30 p. m.	8.95	801.64	691	29	689.4	29	85	27.094	27.031	...	2937	Do do.
Mouth of Canoe creek	21	12.30 p. m.	4.70	806.34	693.4	28.5	691.8	28	82.3	27.151	27.089	...	2867.2	Clear; wind northeast.
† Camp 6, in mountain valley. Not in line of profile.	21	Sunrise	...	...	680.6	5.6	681.9	5.6	39	26.756	26.807	26.772	3170.1	Do do.
	20	Sundown	...	...	679.7	16.5	677.8	16.5	59	26.710	26.637	26.733	...	Clear; wind southwest.
Sacramento river	20	9 a. m.	22.50	828.84	709.9	23.8	708.4	24	72	27.794	27.734	...	2177.2	Clear; wind southeast.
Camp 5, Sacramento river	20	Sunrise	7.50	836.34	717.5	7.5	717.3	7.5	47	28.198	28.190	28.186	1730.3	Do do.
	19	Sundown	...	...	717.4	21	717.7	21	71	28.171	28.183	28.184	...	Do do.
Camp 4, on mountain. Not in line of profile.	19	Sunrise	...	...	708	10	708.3	10	50.5	27.813	27.825	27.819	...	Clear; wind northwest.
	18	Sundown	...	...	708.1	17	707.6	16.9	65	27.833	27.814	27.823	2086.7	Clear; wind west.
Sacramento river	18	10.15 a. m.	26.50	862.84	737.3	25.5	734.1	25.5	76	28.859	28.733	...	1156	Clear; wind northeast.
Camp 3, Sacramento river	18	Sunrise	...	...	739.5	12	736	12	54	29.052	28.910	...	...	Probable error in record of temperature. Not used in computation of altitude of camps.
	17	Sundown	4.70	867.54	737.4	23	733.3	23	74.5	28.955	28.794	...	1078.1	Clear; wind northeast.
Camp 2, Dribblesby's ferry	17	Sunrise	10.50	878.04	738.5	13	737	13	54	29.127	28.950	...	954.2	Clear; wind east.
Mouth of McCloud's river	16	6.45 p. m.	5.25	883.29	742.4	23.5	738.2	24	72	29.094	28.925	...	922	Clear; wind northeast.
Sacramento river	16	11 a. m.	11.75	895.04	745.6	29	741	29	79	29.162	28.981	...	837.5	Do do.
Camp 1, not in line of profile	16	Sunrise	...	...	743.6	21	738.9	21	70	29.170	28.985	28.978	...	Do do.
	15	Sundown	...	...	742.6	31	738.8	31	88	29.121	28.971	29.145	899.9	Clear; wind west.
Fort Reading	12 to 15	...	22.90	917.94	...	...	...	...	...	...	...	...	674.7	Height from mean of four days' observations.

XI.—*Meteorological Observations and Table of Altitudes and Distances for profile from Mud lake to Fort Reading, on the Sacramento river, California, via Noble's Pass.*

Camp 39, east base of Sierra Nevada	June 15 and 16	...	...	642.05	...	...	...	...	...	...	...	...	4118.1	
Point of mountain, shore of Mud lake	16	8 a. m.	3	645.05	661.4	20	661.4	21	65	25.923	25.919	...	4079	
Foot of Madelin Pass, Smoky creek	21	12 m	12	657.05	656.9	27.5	...	...	82	25.720	...	...	4370	Above the line of profile.
Warm springs	21	1 p m.	...	657.05	657	29.5	...	...	86	25.740	...	...	...	
Old shore-line	July 5	8.15 p. m.	30	687.05	658.2	23.5	...	...	75	25.820	...	...	4231.6	Clear.
Camp 55, shore of Honey lake, near boiling springs.	5	9.45 a. m.	7.50	694.55	661	38.4	...	...	88	25.823	...	...	4285.2	Do.
	4	Sundown	8.50	703.05	660.4	25	659.3	25	76	25.908	25.865	...	4094.6	Clear; wind southwest.
	5	Sunrise	...	...	660.1	12	658.9	12	52	25.930	25.883	...	...	Clear; wind northeast.
	5	Sundown	...	...	...	...	658	24	76	...	25.936	25.919	...	Clear; wind southwest.
	6	Sunrise	...	...	...	...	659.6	14.4	56.5	...	25.903	25.896	...	Cloudy; wind northeast.
Willow creek	4	12 m	11.36	714.41	662.4	28.5	661.2	28.5	62	25.932	25.885	...	4080	Clear; wind northeast.
Camp 54, Roop's rancho	3	4 p. m.	8.64	723.05	656.9	32	655.8	32	88	25.770	25.727	...	4181	Clear; wind west.
	3	Sundown	...	...	656.5	26.5	654.5	26.4	78	25.747	25.672	...	...	Clear; wind northeast.
	4	Sunrise	...	...	656.7	11	657.8	11.5	50	25.807	25.846	...	...	
	7	Sundown	...	...	659.7	19	657.9	19	73	25.924	25.853	25.845	...	Clear; wind southwest.

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* Line of profile of Madelin Pass resumed.

† Camps numbered from Fort Reading upward in ascending the river.

XI —*Meteorological Observations and Table of Altitudes and Distances for profile from Mud lake to Fort Reading*—Continued.

Locality.	Date.	Hour.	Intermediate distances.	Distances from Great Salt Lake City.	Bar. reading, No. 496.	Attached thermometer, (C.)	Bar. reading, No. 551.	Attached thermometer, (C.)	Air thermometer, (F.)	Corrected barometer, No. 496.	Corrected barometer, No. 551.	Barometric means.	Altitudes.	Meteorological remarks.
	1854.		*Miles.*	*Miles.*	*Mm.*		*Mm.*			*Inches.*	*Inches.*	*Inches.*	*Feet.*	
	July 8	Sunrise	....	....	660.6	3.5	658.8	3.8	32	25.986	25.915	25.802	....	Clear; wind southwest.
Susan river	8	8 a. m.	4	727.05	658.5	21.8	....	....	96	25.805	....	....	4221.4	Not in profile.
Top of ravine, (same point as above)	8	8.15 a. m.	....	....	647.5	21.3	....	....	64	25.372	....	....	4672.2	Clear; wind southwest.
Susan river	8	10 a. m.	4	731.05	649	21.5	....	....	67	25.411	....	....	4643.6	Not in profile.
12 o'clock peak	8	12 m	....	....	623	24.5	....	....	71	24.401	....	....	5801.5	Clear; wind southwest.
Susan river	8	2 p. m.	4.50	735.55	642.8	25	....	....	78	25.220	....	....	4909.7	Do do.
Divide between Susan river and Summit creek	9	9.45 a. m.	7.25	742.80	632.1	25.5	....	....	76	24.730	....	....	5454.1	Do do.
On lake, up Susan river	9	11.20 a. m.	7.25	750.05	627.2	26.2	....	....	77	24.538	....	....	5679.4	Do do.
Divide between Summit and Pine creeks	9	12.45 p. m	2.25	752.30	626.8	28.5	....	....	80	24.448	....	....	5801.6	
Pine creek, prairie	9	12 m	5	757.30	....	....	627.6	29	79	....	24.562	....	5663.3	Do do.
Plains of the Sierra Nevada	9	1.20 p. m.	2.89	760.19	....	....	631	27.8	80	....	24 726	....	5480.5	Clear; wind west.
	9	2 p. m.	1.84	762.03	....	....	630	28	81	....	24.700	....	5516.3	Clear: wind southwest.
Thick pine woods	9	2.40 p. m.	1.70	763.73	....	....	632.8	28.8	83	....	24.816	....	5394.1	Do do.
	9	3.45 p. m.	2.05	765.78	....	....	635.2	28.2	82	....	24.928	....	5261.1	Do do.
Camp 59, Black Butte creek	9	Sundown	1.55	767.33	634.7	19	634.8	19	60	24.935	24.939	....	5084.8	Do do.
	10	Sunrise	....	....	633.4	4.7	634.3	4.7	34	24.903	24.940	....	....	Do do.
	23	Sunrise	....	....	632.9	2	634.9	2	32	24.896	24.975	....	....	Clear; wind northwest.
	23	Sundown	....	....	634.3	20	633.8	20	71	24.896	24.939	24.909	....	Clear; wind southwest.
	24	Sunrise	....	....	633.3	6	634.4	6	45	24.915	24.895	24.937	....	Clear; wind southeast.
Bed of dry creek, above Black butte	10	11.40 a. m.	11.69	779.02	614.8	27	613.5	27.3	80	24.069	24.017	....	6275.4	Clear; wind southwest.
Near a pond	10	12.30 p. m.	1.87	780.89	615.3	26.8	613.9	27	77	24.098	24.042	....	6223.4	Do do.
Small creek and springs	10	1.10 p. m.	1.53	782.42	616.1	27	614.7	27	81	24.144	24.089	....	6194.3	Do do.
Hat creek	24	11.40 a. m.	3.75	786.17	616	30.5	....	....	80	24.093	....	....	6216.2	Do do.
Side of mountain, west of Hat creek	24	1 p. m.	2.75	788.92	618.1	30.5	....	....	81.5	24.206	....	....	6092.3	Do do.
Spur dividing valley of Wolf creek	24	2 p. m.	.50	789 42	620.1	32.5	....	....	88.5	24.309	....	....	6015.1	Do do.
Wolf creek	24	2.30 p. m.	1.50	790.92	621	32	....	....	89	24.339	....	....	5983.1	Do do.
Western summit of Sierra Nevada	25	7 a. m.	2	792.92	616.8	18.5	615.4	18.5	69.5	24.185	24.130	....	6074.1	Cloudy; wind southwest.
	11	10 a. m.	....	....	623.8	28.5	622.8	28.9	84	24.397	24.289	....	5948.2	Clear; wind southwest.
Battle creek	25	8 a. m.	5	797.92	626.6	28	624.4	28	90	24.523	24.435	....	5825.1	Cloudy; wind southwest.
	11	11 a. m.	2.50	800.42	638.2	29.5	636.7	30	85	24.945	24.884	....	5293.6	Clear; wind southwest.
Western descent of Sierra Neveda	11	12 m.	2.12	802.54	651.1	30	649.7	30	86	25.478	25.423	....	4691.5	Do do.
Deer flat	11	1 p. m.	2.14	804.68	659.2	31	657.8	31	87	25.811	25.768	....	4318.1	Do do.
Western slope of Sierra Nevada	11	2 p. m.	1.69	806.37	662.8	31.6	661.7	31.6	88	25.971	25.928	....	4146.3	Do do.
Hill's rancho, on Battle creek	25	3 p. m.	2	808.37	662.4	29	659.9	29.5	80	25.980	25.880	25.967	4131.6	Cloudy; wind southwest.
	25	Sundown	....	....	661.1	23	658.7	22.8	73.5	25.954	25.861	25.870	....	Cloudy; wind northwest.
Descending Sierra Nevada	11	5 p. m.	4.14	812.51	666.2	28	664.6	28	82	26.154	26.087	....	3934.7	Clear; wind southwest.
	11	7.20 p. m.	3.58	816.09	674.9	26	....	....	80	26.567	....	....	3445.7	Do do.
Camp 61, McCumber's mill	12	Sunrise	1	817.09	675.2	16	672.7	16	59	26.500	26.402	....	3491.1	Clear; wind northeast.
On stream	12	8 a. m.	2.38	819.47	678.3	26.3	676.1	26.5	78	26.555	26.468	....	3497·8	Clear; wind southwest.
Descent	12	9.30 a. m.	3.05	822.52	696.3	30.3	694.9	30.5	86	27.227	27.172	....	2796	Clear and calm.
On stream	12	10 a. m.	2.19	824.71	709.6	32.5	707.9	32.5	91	27.741	27.671	....	2280.2	Calm.
On descent in valley	12	11.30 a. m.	3.78	828.49	727.8	37.5	726.4	37.9	99	28.435	28.380	....	1576.4	Clear; wind northeast.
	12	12 45 p. m.	2.93	831.42	740.5	40.7	737.9	41	106	28.951	28.848	....	1087.4	Do do.
On dry creek	12	1.45 p. m.	2.54	833.96	745.8	42.7	742.4	42	109	29.167	29.037	....	887.3	Clear; wind northwest.
	12	3.40 p. m.	4.37	838.33	749.5	41.6	746	42	108	29.351	29.213	....	706.5	Do do.
Fort Reading, camp 62	12	Sundown	2.25	840.58	750.3	36.2	744.3	36.5	100	29.396	29.190	....	674.7	Do do.
	13	Sunrise	....	....	750.2	20	746.5	20	67	29.434	29.288	....	....	Clear and calm.
	13	Sundown	....	....	748.5	35	744.8	35.5	95	29.333	29.184	....	....	Clear; wind southeast.
	14	Sunrise	....	....	749.4	25.5	744.9	25.3	72	29.375	29.198	....	....	Clear; wind northeast.
	14	Sundown	....	....	748.7	34.2	744.3	34.5	93	29.345	29.168	29.386	....	Do do.
	15	Sunrise	....	....	750.3	26.2	745.8	26.5	79	29.434	29.228	29.209	....	Do do.

XII.—*Meteorological Observations and Table of Altitudes on the road leading through Noble's Pass.**

Locality.	Date.	Hour.	Intermediate distances.	Distances from Great Salt Lake City.	Bar. reading, No. 496.	Attached thermometer, (C.)	Bar. reading, No. 551.	Attached thermometer, (C.)	Air thermometer, (F.)	Corrected barometer, No. 496.	Corrected barometer, No. 551.	Barometric means.	Altitudes.	Meteorological remarks.
	1854.		*Miles.*	*Miles.*	*Mm.*		*Mm.*			*Inches.*	*Inches.*	*Inches.*	*Feet.*	
Ascent of Noble's Pass	July 8	7.30 a. m.	1.04	....	....	....	653	18	58.5	....	25.609	....	4385.1	Clear; wind northeast.
	8	8.45 a. m.	2.72	....	....	....	647.8	19.3	61.5	....	25.389	....	4641.3	Do do.
Ascent of Noble's Pass, (small stream)	8	10 a m.	2.51	....	....	....	641.1	21.5	65.5	....	25.100	....	4980	Do do.
	8	11.15 a. m.	2.77	....	....	....	633.4	21	67.5	....	24.804	....	5322.5	Do do.
Ascent of Noble's Pass, (spring)	8	12 m.	1.43	....	....	....	632.6	22.7	70	....	24.786	....	5356.4	Do do.
	8	1.30 p. m.	2.84	....	....	....	620.3	23.2	69.5	....	24.330	....	5874.5	Do do.
	8	2.20 p. m.	1.69	....	....	....	617.6	25.3	72	....	24.235	....	6000.1	Do do.
Eagle butte, overlooking lake	3	9.40 a. m.	....	....	609.4	19	609.1	19.6	66	24.871	24 859	....	6392	Clear.
	8	3.40 p. m.	2.28	....	....	....	623.6	24.5	75.3	....	24.489	....	5726.1	Clear; wind southwest.
Camps 53 & 58, Summit creek	2	Sundown.	2.35	....	623.5	16	622.7	16	60	24.499	24.467	....	5460	Clear; wind west.
	3	Sunrise.	....	....	622.5	1	623.7	.7	29	24.503	24.551	....	....	Clear and calm.
	8	Sundown.	....	....	626.1	17	625.4	17	60	24.609	24.582	24.561	....	Clear; wind southwest.
	9	Sunrise.	....	....	626.1	0	627.1	0	29	24.635	24.674	24.568	....	Clear; wind northeast.
In direct line for Pine creek	9	8.15 a. m.	3	....	....	....	626.4	20	65	....	24.544	....	5603.2	Clear; wind southeast.
	9	9.10 a. m.	3	....	....	....	628.8	22.9	73.5	....	24.605	....	5582	Do do.
Open prairie, near Pine creek	9	11 a. m.	1.65	....	....	....	629	28	79	....	24.589	....	5632.5	Clear; wind west.

XIII.—*Meteorological Observations and Table of Altitudes in crossing from the mouth of Canoe creek (Poinsett river) to Black Butte creek, and thence west to Hat and Wolf creeks.**

Camp 7, Canoe creek	July 21	Sundown.	....	....	687.7	19.5	686.4	19.5	68.5	27.012	26.961	27.022	2897.5	Clear; wind northwest.
	22	Sunrise.	....	....	687.5	4.3	687.7	4	41	27.033	27.043	27.002	....	Clear; wind northeast.
In a ravine	22	12.30 p. m.	....	....	666.4	28.5	665	28.5	82	26.095	26.040		3992.1	Do do.
West from camp on Black Butte creek, 4 miles.	24	8.15 a. m.	....	....	634.1	27.5	....	....	78	24.815	....	....	5367.6	
West from last reading 2.50 miles, in valley of Canoe creek, (Poinsett river.)	24	12 m.	....	....	657.3	33.5	....	....	91	25.706	....	....	4400.6	
Hat creek—distance given from spring	10	3.30 p. m.	4.49	....	640.2	30.8	638.9	31	87	25.111	25.059	....	5108.4	Clear; wind southwest.
Camp 60, Wolf creek	10	Sundown.	3	....	633.6	23.5	631.8	23.5	74.5	24.872	24.802	24.871	5245.3	Do do.
	11	Sunrise.	....	....	633.1	10.5	632.2	10.5	49	24.870	24.834	24.818	....	Clear; wind east.
Camp on Wolf creek one mile below the preceding camp.	24	Sundown.	1	....	634.5	23.5	635	23.8	76.5	24.909	24.920	24.899	5185.5	Thunder; wind southwest.
	25	Sunrise.	....	....	633.6	10	634	10	51	24.890	24.906	24.913	....	Cloudy; wind southwest.

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* This table is not used in profile.

CHAPTER X.

Geology.

I.—Geological report of the country explored under the 38th and 41st parallels of north latitude, in 1853–'54, by **James Schiel**, M. D., Geologist for the expeditions.

II.—Letter from Professor J. W. Bailey, upon infusorial fossils submitted to him by Dr. Schiel.

SIR: In the report which I have the honor herewith to transmit to you, I have endeavored to give a description of the geology of the country through which we travelled after leaving Westport. It may, perhaps, more properly be termed a geology of the road over which we travelled, since the geological exploration had to be confined to those parts of the country which lay in the immediate neighborhood of that road. I have not entered in this report into a too minute, and therefore tiresome description of details; nor have I attempted to found unwarrantable generalizations on restricted and, from their very nature, insufficient observations; but I have tried to represent, in as small a picture as possible, the chief geological features of the explored country. Many things that would have to be mentioned in an independent geological paper—as the shape and elevation of mountains and mountain chains, the configuration of the different parts of the explored country, &c.—have been omitted as a useless repetition of what has been given in your general report of explorations.

In describing the sedimentary rocks of the plains, it must, of course, be left undecided whether, in the succession of the strata as they have been enumerated, there are still some other strata lying between, for sometimes we travel a great distance, and the level changes many hundred feet before we meet again with an accidental outcropping of rock.

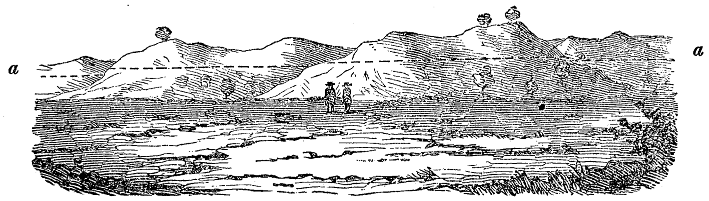
Between Westport and the Little Arkansas there is a series of limestone strata composed of rocks which differ in appearance and physical properties, fracture, color, hardness, &c., but which must, nevertheless, be considered as members of one and the same formation. Of the limestone around Westport, which extends into the Shawnee territory, (now Kansas), there is a denudation on a creek near our first camp. It is in some places densely filled with petrifactions, *Terebratula subtilita*, *Spirifer*, (*striatus ?*) *Productus splendens*, and two species of *Productus* not to be determined from my specimens, apparently a new species of *Phillipsia*, so as to appear almost as a conglomerate of these shells.

On Indian creek we find a limestone of a yellow red color, not very hard, and interspersed with white crystal leaves belonging to the organic remains of the rock, which have become obliterated by crystallization. It would be impossible to recognise to what kind of organism they belonged, but for the agency of the creek, which, in running over the rock, dissolves the softer part of it, leaving the crystallized parts behind, so that the whole surface of this limestone along the creek is thickly overspread with fossils. They are mostly parts of broken stems of a species of encrinites, fragments of some bryozoa and of some other undistinguishable shells.

The next limestone, found near Willow creek, is gray, hard, of subcrystalline fracture, and includes fossils, *Fenestella*, *Productus semireticulatus*, and *Productus œquicostatus*.

More westward, up to the Little Arkansas, we meet, from distance to distance, with outcroppings of limestone strata, but the rock becomes more compact, sometimes excessively hard, and petrifactions are extremely rare, if they are not wanting entirely. I found in one case only a fragment of a small trilobite in a limestone west of Willow creek. The dip of all these strata, which must be considered as members of the coal formation, is a few degrees northeast.

A white, fine-grained, non-fossiliferous limestone on the Little Arkansas, and a red ferruginous sandstone, out of which Pawnee rock is formed, have a horizontal stratification. The latter is again found on Coon creek, and, according to a specimen brought to me by Captain Gunnison, it extends up to the Republican fork of the Kansas river. It supports a loose conglomerate of quartzose rocks, which is seen to extend some thirty miles along the Arkansas west of Fort Atkinson. It is very probable that these strata belong to the chalk formation, which, going westward, we find distinctly represented by several kinds of limestone strata; the first, about ninety miles from the fort, is a soft, argillaceous, yellowish limestone, with inoceramus. It seems to have a slight dip to the southwest. About thirty miles farther west, we meet with another limestone of the cretaceous period. It is a gray rock, a little harder than the preceding one, and is replete with inoceramus mytiloides. The row of low hills which, in these localities, stand at a short distance from, and extend along the road, consist of this limestone. These hills show lines which mark the banks of an ancient sea; they lie in one and the same horizontal plane, in whatever direction these hills may run.



View of the limestone hills of the valley of the Upper Arkansas: the broken line, *a*-----*a*, showing the positions of ancient shores.*

* *Note by Lieut. Beckwith.*

The old shore-lines existing in the vicinity of the Great Salt Lake present an interesting study. Some of them are elevated but a few feet (from five to twenty) above the present level of the lake, and are as distinct and as well defined and preserved as its present beaches; and Stansbury speaks, in the Report of his Exploration, pages 158–160, of drift-wood still existing upon those having an elevation of five feet above the lake, which unmistakably indicates the remarkably recent recession of the waters which formed them, whilst their magnitude and smoothly-worn forms as unmistakably indicate the levels which the waters maintained, at their respective formations, for very considerable periods.

In the Tuilla valley, at the south end of the lake, they are so remarkably distinct and peculiar in form and position, that one of them, on which we travelled in crossing that valley on the 7th of May, attracted the observation of the least informed teamsters of our party—to whom it appeared artificial. Its elevation we judged to be twenty feet above the present level of the lake. It is also twelve or fifteen feet above the plain to the south of it, and is several miles long; but it is narrow, only affording a fine roadway, and is crescent-formed, and terminates to the west as though it had once formed a cape, projecting into the lake from the mountains on the east—in miniature, perhaps, not unlike the strip of land dividing the sea of Azoff from the Putrid sea. From this beach the Tuilla valley ascends gradually towards the south, and in a few miles becomes partly blocked up by a cross-range of mountains, with passages at either end, however, leading over quite as remarkable beaches into what is known, to the Mormons, as Rush valley, in which there are still small lakes or ponds, once, doubtless, forming part of the Great Salt Lake.

The recessions of the waters of the *lake* from the beaches at these comparatively slight elevations, took place, beyond all doubt, within a very modern geological period; and the volume of the water of the lake at each subsidence—by whatever cause produced, and whether by gradual or spasmodic action—seems as plainly to have been diminished; for its present volume is not sufficient to form a lake of even two or three feet in depth, over the area indicated by these shores, and, if existing, would be annually dried up during the summer.

These banks—which so clearly seem to have been formed and left dry within a period so recent that it would seem impossible for the waters which formed them to have escaped into the sea, either by great convulsions, opening passages for them, or by the gradual breaking of the distant shore (rim of the Basin) and draining them off, without having left abundant records of the escaping waters, as legible at least as the old shores they formed—are not peculiar to the vicinity of this lake of the Basin, but were observed near the lakes in Franklin valley, and will probably be found near other lakes, and in the numerous small basins which, united, form the Great Basin.

But high above these diminutive banks of recent date, on the mountains to the east, south, and west, and on the islands of the Gaeat Salt Lake, formations are seen, preserving, apparently, a uniform elevation as far as the eye can extend—formations on a magnificent scale, which, hastily examined, seem no less unmistakably than the former to indicate their shore origin. They are elevated from two or three hundred to six or eight hundred feet above the present lake; and if upon a thorough examination they prove to be ancient shores, they will perhaps afford (being easily traced on the numerous mountains of the Basin) the means of determining the character of the sea by which they were formed, whether an internal one, subsequently drained off by the breaking or wearing away of the *rim* of the Basin—of the existence of which at any time, in the form of continuous elevated mountain chains, there seems at present but little ground for believing—or an arm of the main sea, which, with the continent, has been elevated to its present position, and drained by the successive stages indicated by these shores.

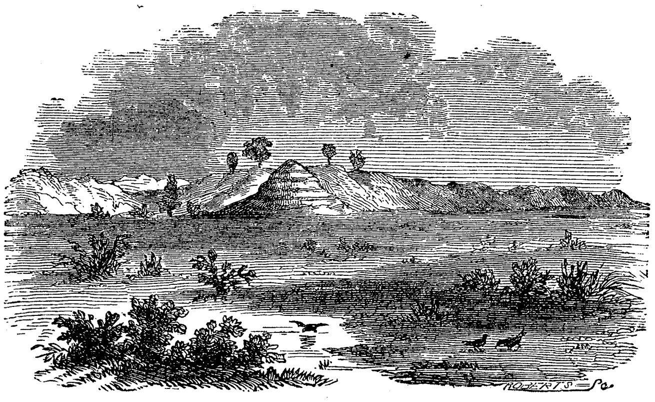
At some distance east of Bent's Fort, a hard, compact, gray limestone has an outcropping on the road. It does not seem to include any organic remains; but a yellow red sandstone lying over it contains numerous impressions of shells. It is so soft that in transporting them the specimens of it were crushed to powder in the first hour, and I am left unable to determine to what species they belong. As much as I can recollect of them, they may belong to some species of pecten.

The chain of high and steep bluffs which begins some miles above Bent's Fort, is chiefly made up of two kinds of limestone; the upper one white, pure, hard, and fine-grained nearly to compactness, includes no organic remains, and would, if located in a less remote part of the country, offer a very valuable material to the practical arts, or for building purposes; the lower, a brownish rock, is interspersed with thin layers of crystals of carbonate of lime, and bears some indications of petrifactions, but so undistinguishable that it is hardly possible to make out what they are. The stratification of both is horizontal. To judge partly from what I saw myself, partly from specimens brought to me, a blackish, hard limestone and a soft shale support them; the latter cropping out some twenty miles west of the fort in a kind of bottom land.

Having crossed the Arkansas near the mouth of the Apishpa, (presumed Huerfano,) our road leads over a gravelly and, in general, sterile soil—we are in the great American desert—and over sandstone, through which a number of creeks and rivers have cut their channels. The underlayers of this sandstone are a yellowish, hard, fine-grained rock, the upper part soft, and eaten through by the atmospheric agents.

A few miles east of the cañon through which we entered the mountains proper, a hard, compact, dark-gray limestone, with some slight traces of petrifactions and sulphuret of iron interspersed, and above it a limestone which is apparently identical with the lower brownish limestone near Bent's Fort, crop out with a dip of 8° to 9° to the northeast. They rest on a hard silicious shale, through which igneous rocks have made their eruption near the mountains, forming buttes of sometimes remarkable shape. The most remarkable of them is the Huerfano butte, a little mountain of conical shape, consisting of black granite (quartz and black mica) and the just-mentioned hard silicious shale, the latter lying on the top of the butte.

In concluding the geology of the Plains, I will here mention a kind of geological riddle which I have not been able to solve: About fifteen yards distant from the above-mentioned limestone hills of the cretaceous period, there is a little butte almost as high as the hill to which it stands nearest—about thirty-five feet—and of a shape which will be best seen from the accompanying drawing of it. It stands quite isolated, and consists not of limestone, but of a soft foliating shale. Even should that shale be found to support the limestone of these hills—which I could not decide, not having any instruments to dig into the ground—it would still



Isolated Shale Butte, standing adjacent to the limestone hills in the valley of the Upper Arkansas.

appear strange that the shale of this butte could lie in the same horizontal plane with the limestone of the hills, and that it should have resisted devastation so long.

An analysis of atmospheric air, which I made in the neighborhood of Fort Atkinson, may also properly find a place here. The mean of three analyses executed with all care after the method of Prof. v. Liebig—absorption of the oxygen by a solution of pyrogallic acid in caustic potash—gave:

Nitrogen	79.09
Oxygen	20.91
	100

This shows, as was to be expected, that the composition of the air on the high prairie does not differ from the well known invariable composition of atmospheric air elsewhere.

On entering the mountains we find a white, fine-grained, very hard sandstone, torn, fractured, and upheaved to nearly a vertical position by plutonic rock. The steep slopes of the mountains are covered with fragments of a white silicious rock, which in some places are of considerable size, forming blocks of twenty and more feet in diameter. The hills on the foot of the higher mountains are covered with drift rocks of all kind—quartz, porphyry, sandstone, &c.; even hypersthene rock is occasionally met with. About fifteen miles west of the cañon through which we entered the mountains, sandstone, and a red shale lying under it, are nearly vertically uplifted by a trachytic porphyry, which seems to have given to those mountains their peculiar shape and elevation. This porphyry consists of a brownish gray, rough base, in which a great number of crystals of feldspar and crystals of black mica are imbedded, forming a rock of great beauty. The crystals of feldspar and mica are mostly perfect, and of the size of one to two tenths of an inch; the latter are hexaëdrix prisms, with basal cleavage. This rock, which forms the ridge from the trail in Sangre de Cristo to the route laid down by Captain Gunnison through that pass, seems to be of a very changeable character. East of the ridge the base of it is of a purer gray, the number of feldspathic crystals is less, and the numerous mica crystals are smaller, sometimes almost of microscopic size; but the basal cleavage is still easily detected. West of the ridge, the mica seems to have passed into tourmalin, the crystals of feldspar being scarce. The rock contains sometimes tolerably large crystallizations of a zeolitic substance, which for its physical properties and crystal form, as well as behavior before the blow-pipe, must be considered as stilbite. The predominating rock in the Sangre de Cristo valley is a feldspathic granite, passing gradually into gneiss on the right bank of the creek, the gneiss supporting a hard shale, sandstone, and a bluish brittle limestone. The latter belong perhaps to that class of non-fossiliferous transition rocks lying under the silurian system,* and the existence of which on this continent has been recognised by several distinguished geologists.

In the neighborhood of Fort Massachusetts there are indications of iron ore, and even faint indications of cobalt ore, but I had neither the time nor the means to follow them up.

In the sandy, and for the most part sterile, San Luis valley, I looked in vain for some section or outcropping of the rock lying under the soil. During many days' travelling, this valley presents nothing but sand; and it was not even possible to ascertain the character of the under-soil. A striking and very curious illustration of the abundance of sand in this valley is found in an isolated row of sand-hills opposite Roubideau's Pass. They are from 500 to 600 feet high, running for several miles in a direction from northwest to southeast. It is very probable that some solid rock is buried under this sand, having been the cause of its accumulation. Along the foot of the White mountains (Sierra Blanca) we found numerous boulders of igneous rocks which do not seem to correspond with the rocks of the neighboring mountains.

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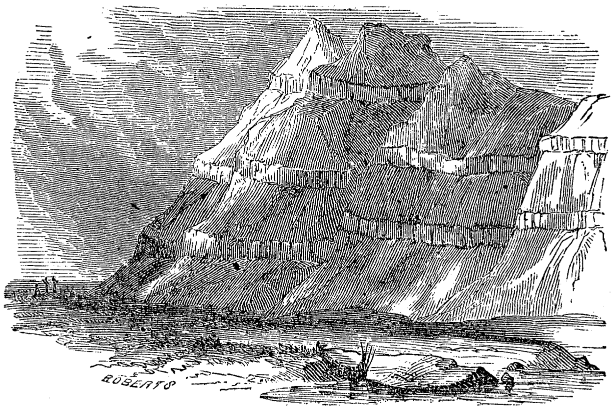
* The cambrian system, as distinguished from the silurian system by its age and organic remains, is not recognised any longer by geologists. Comp. Murchison, in Quarterly Journal Geology, soc. VIII, 1852. Murchison's Siluria, 1854.

The chief rock of the Sierra Blanca in and around Roubideau's Pass is an altered, rough, bluish violet, mica slate, through which quartzose, granitic, and porphyritic rocks have erupted, including pieces of each other, so as to form quite a chaos of rocks.

The entrance to the beautiful Sahwatch valley is marked by an isolated butte of hard, gray, granitic porphyry, with glassy feldspar and mica. The valley is formed by picturesque mountains, which are steep, often vertical, or of a true trapp form on the south side, less steep and covered with timber on the north side, where the destruction of the mountains by the melting snows, rains, &c., is less rapid. The rock which constitutes these mountains is a red trapp-porphyry,* with a red feldspathic base, with glassy feldspar and mica. Thin splinters of this base melt with difficulty, on the edges, before a well-directed jet of the blow-pipe.



Limited view of Trapp Rocks, (visible throughout the valley of the Sahwatch creek and its branches,) in ascending the Coochetopa Pass from the east.

[*NOTE.—The term trapp is used so vaguely, and with so little distinction, that it is often impossible to know what kind of rock is meant by that name. With some authors it seems to designate any kind of igneous, not granitic, rock. That this looseness of language is a general one, will appear from quotations from three distinguished geologists:

"Connected with the aforementioned rocks—diallage rocks, (euphotides;) hypersthene rocks; pyroxene rocks, including basalt, dolerite or greenstone; amphibolic rocks, including diorite or greenstone; trachytic and porphyritic rocks—there is a whole series of rocks which agree with those in so far as all of them contain only simple silicates, whilst the granites and their neighbors, containing an excess of silica, are multi-silicates. But what distinguishes the trappean rocks from all the preceding ones, is *the want of any perceptible structure;* not even the microscope shows any structural elements in the trapp rocks. They are in some manner related to the basalts; they have the same volcanic origin, were in a state of fusion at the time of their formation, and separate like those in regular masses, or even in hexaëdrix prisms. All these rocks, which Haüy called 'aphanites' on account of *their undeterminable structure,* are rough to the touch. It is probable that chemical analysis will offer the means of classification for these rocks; at present this is impossible. In his examination of the trapps of the Ferroe islands, Durocher has pointed out the way chemical analysis has to follow in this respect; he has shown these trapps to consist of two varieties, of which one must be reckoned amongst the hyperites, the other amongst the euphotides; the latter being easily distinguished by its yielding water when heated."—*Elie de Beaumont, in his "Cours de Géologie à l'école des Mines," German version, by C. Vogt.*

"Trapp or greenstone is a dark and heavy blackish-green or brownish rock, consisting of hornblende and feldspar; it *usually has a crystalline texture,* but is sometimes compact. When albite replaces the feldspar, it is called *diorite* and *diabase.* Basalt is a similar rock, &c., &c." *Dana's Mineralogy,* (3*d edition.*)

"*Trapp* and *trappean rocks.* Volcanic rocks, composed of feldspar, augite, and hornblende.

The various proportions and state of aggregation of these simple minerals, and differences in external forms, give rise to varieties which have received distinct appellations, such as basalt, amygdaloid, dolerite, greenstone, and others. The term is derived from trappa, a Swedish word for stairs, &c., &c."—*Lyell: Principles of Geology.*]

More westward the mica in this rock becomes scarce, though it never disappears entirely from it. Near camp 53, where we left the Sahwatch creek in order to go over the pass, the mountains on the right bank of the little creek, coming down from the north, are composed of a kind of granitic rock, black mica imbedded in a crystalline mass of glassy feldspar. The only sedimentary rock found between Sangre de Cristo valley and Coochetopa creek was a hard, fine-grained sandstone near the divide of the Sierra St. Juan.

On the west side of the Coochetopa Pass, we meet again with two kinds of porphyry; the one resembling the gray porphyry of Sangre de Cristo, the other that of the Sahwatch butte, containing, however, more mica. In the lower regions of the mountains, forming the valley of the Coochetopa creek and the Grand River valley, feldspathic granite, gneiss, a rough silicious shale and a fine mica slate, the latter dissolving only under a powerful lens into a mixture of quartz and mica, and a white sandstone, are the predominating rocks; in the upper regions, sandstone and trapp-porphyry, the latter resembling very much the trapp-porphyry of Sahwatch valley. It consists of a compact, hard, brown-violet feldspathic base, interspersed with crystallized glassy feldspar, and a few mica crystals. Thin splinters of this base melt more easily on the edges before the blow-pipe than the Sahwatch porphyry. This rock lies mostly horizontal, about sixty to seventy feet thick, on the summit of the mountains, over a white sandstone, forming sometimes remarkable platforms. It seems to have an immense extension, for we found it for over a hundred miles along our road. As it must necessarily have been in a state of fusion at the time it spread over the sandstone, we may form an idea as to the scale on which eruptions of igneous rocks have taken place at a time when sedimentary strata of considerable thickness were already in existence.

By contact with granite, this rock has in some places (along Grand river) become blackish and very brittle. It seems to have been displaced when already in a solid state, for it has polished surfaces which could only be produced by its sliding over some other solid rock. I cannot positively assert that this rock is an altered trapp-porphyry, for I could nowhere trace a direct connexion; but in their lithological character, they stand very near each other. The narrow cañon of Grand river, below camp 58, is formed of granite and this rock. Some miles above that cañon, a conglomerate of igneous rocks of all kinds, imbedded in a very hard cement, lies under the sandstone; and when, during and after the gradual upheaval of the mountains, the other rocks were completely washed and worn away, this conglomerate partially resisted the action of time and the weather, so that parts of it are seen hanging over the steep sides of the mountains in the shape of towers, resembling very much those ruins of old castles which, though remnants of barbarous ages, give unequalled charms to so many landscapes in the eastern world. The great hardness of the cement of this conglomerate—I nearly broke my steel hammer in the attempt to break some pieces off—induced me to make some chemical experiments as to its composition. It consists, however, of nothing but impure carbonate of lime, being entirely soluble in diluted chlorhydric acid. The solution evaporated to dryness, and re-dissolved, does not leave a trace of silica behind.

The country between the St. Juan and Wahsatch mountains is a barren, dreary desert. The road leads mostly over sand or its generator, sandstone; which latter constitutes the several smaller mountain ranges between these two great chains. Sandstone, assuming all shades of color, sandy calcareous clay slate, argillaceous limestone of green and red colors, sandy shale, and, uppermost, a soft foliating shale from gray to black, including much fibrous and lamellar gypsum, seem to be the formations composing the "Elk mountains." All these different strata are concordant, and of a slight northeast dip. Some miles distant from where we crossed the Nah-un-kah-rea, blocks of a dark trachytic porphyry lie over the sandstone and shale, extending some miles along our road. Boulders of this trachytic rock are occasionally met with quite up to the Wahsatch mountains In the valley of the Blue river, a coal measure, supported by sandstone, crops out at several places; but the coal does not seem to be of a good quality. Not far from where the latter river empties into Grand river, a hard conglomerate of pebbles baked together, a hard, bluish limestone, and a dark, silicious shaly rock, with agate, are met with, but do not seem to have a great extension.

That the disintegrations of such rocks cannot yield a good soil is evident, and not much organic life can be expected in such a country. But there does not even seem to have been any organic life in the ancient seas, in which the sedimentary rocks of this country have been deposited. I could not detect any rock including organic remains of any kind whatever. It is true, in the neighborhood of Grand river, near camp 72, there are fragments of a dark gray limestone, with numerous casts of shells—mostly fragments of amonites—strewed over the ground on the top of a sand-hill, together with quite a number of loose shells, "Gryphæa pitcherii," showing the rock to have originated in the cretaceous period; but within a circuit of several miles, it could not be found in situ. The want of petrifactions in the rocks of these desolate regions, renders a determination of their relative ages somewhat hazardous.

It is a remarkable feature in the character of the country between the Rocky mountains and the Sierra Nevada, that whole formations disappear, as it were, before our eyes. The wearing and washing away of mountains takes place here on an immense scale, and is the more easily observed, as no vegetation of any account covers the country, hiding the destruction from the eye. Nature here seems only to demolish, without showing any compensating creative activity. Days before we found the above-mentioned towery conglomerate on Grand river, we saw mostly small pieces of rocks on the road which did not belong to the surrounding mountains, and which afterwards could be identified with the rocks contained in that conglomerate. As these rocks could not have been drifted there from a place about a thousand feet lower, we must conclude that large masses of this conglomerate have been carried away, leaving a number of these rocks behind. All along our road in the Grand and Green river country, on the slopes of high mountains, and in the level country, the soil is overstrewed with pieces of agate, cornelian, calcedony, and other quartzose minerals, which I could not refer to any rock. In the neighborhood of the Wahsatch mountains, these minerals again make their appearance; but here they are traceable to a rock which still constitutes a great part of the mountains of this range. The devastation may here be followed step by step. A similar process has been going on in the country of Blue and Green rivers with other strata. The black, soft shale, with gypsum and the strata below it, have disappeared from an immense tract of land. For days before we struck Green river, we travelled over a black, clayish, absolutely sterile soil, produced by the decaying mountains, and in different places, chiefly at a short distance from where we crossed Green river, we found remnants of those strata in buttes of sometimes considerable height, some of them assuming the shape of huge chimneys.

On the foot of the Wahsatch mountains, close to Akanaquint creek, and about a mile from camp 88, a coal measure of an excellent bituminous coal crops out. It rests on sandstone, a thin layer of a brown, soft clay intervening between them, and is about three feet thick on the outcropping.

As soon as we are over the first ridge of the Wahsatch mountains, porphyritic rocks again make their appearance, and their disintegration again gives rise to a better soil and more luxuriant vegetation. These porphyries, from red to dark gray, belong undoubtedly to different periods. One of them erupted, when an oolitic limestone covered the country. At a short distance from our road over the second high ridge, numerous pieces of this limestone may be seen. That the presence of the latter rock in these localities is not merely accidental, is proved by the fact that by contact with the porphyry it has been altered, and has baked together with it. White sandstone, a white, very pure, compact limestone, a greenish and a red argillaceous limestone, and a sandstone containing mica, are the sedimentary rocks of the Wahsatch mountains in the region of Swambah creek. None of them contain fossils.

A bed of pure crystallized gypsum in the valley of the Ungot-tah-bi-kin creek, deserves to be particularly mentioned. The crystals are imbedded in a red or green marl in such abundance as to form a whole mountain of this valuable mineral. The section of the bed, about a mile from our road, extends about forty feet above the level of the soil, and it has very likely a considerable depth.

In many parts of the Wahsatch and Tuilla mountains, a silicious rock, mostly calcedony and agate, breaks through a gray-white or gray limestone, infiltrating the latter, and forming veins of sometimes considerable thickness. The cañon leading to Swambah creek, and the ridge of the Tuilla mountains east of Cedar creek, consist of this infiltrated limestone.

On Swambah creek I found an extraordinarily large block of crystals, apparently calcareous spar. They were white, semi-transparent, of granular fracture, and consisted of—

Carbonate of lime	93.66
Carbonate of magnesia	4.12
Carbonate of protoxyd of iron	2.02
Water	0.20
	100

To the simple minerals occasionally mentioned heretofore, the following may be added:

Dolomite, found in the valley of Ungot-tah-bi-kin creek.

Hyalite, in the trapp-porphyry of the valleys of Coochetopa creek and Grand river.

Sulphuret of molybdena, in the Wahsatch mountains.

Asphaltum, in different places in the Wahsatch and Tuilla mountains.

Had the Indian difficulties during last winter made geological excursion in Utah Territory admissible, the extraordinarily deep snows of that winter would have made them quite useless, if not impossible. For the same reason, our winter excursion into the Wahsatch mountains and Green river country, resulted quite unproductively in geological facts, and I am not able to add anything new to the geology of that country, as it has been described in former reports, with the exception, however, of a phenomenon which the Great Salt lake offers, and which not only possesses a scientific interest, but may be made of great importance to the development of chemical arts in the valley of the "Saints."

In summer the evaporation of the water of the lake is so great, and the solution of salts becomes so concentrated, that a part of them is deposited on the bottom of the lake. In some places, I have been told, this sediment has been found to be two feet thick. It consists of variable quantities of *sulphate of soda* and chloride of sodium, the sulphate exceeding by far the chloride, at least in the specimens which came under my examination. In the manufacturing of soda, an immense capital is annually wasted in producing this sulphate, which is finally converted into carbonate of soda. It can be had here for the mere trouble of taking it out of the lake.

Another interesting mineral production of the localities around that remarkable lake is found in great quantity at Alum Point, and in other places in Utah Territory. It is the manganesian or feather alum, a mineral of great use in the so-called tawing process, and an excellent material for preserving the skins of birds and other animals. It has rather been considered hitherto as a rare mineral.

The composition of this alum does not seem to be constant; at least not in relation to its proportions of water. I obtained from one specimen 37.25 per cent. sulphuric acid, and 39.45 per cent. of water; and from another 37.26 per cent. sulphuric acid, and only 32.85 per cent. of water. There was no time to complete the analysis.

In the regions between the Tuilla mountains and the Sierra Nevada, the desert character is not so constantly preserved as in the country east of the Wahsatch mountains, and the soil offers in many places, as far as its chemical composition is concerned, by far more resources. The slopes of the mountains west of the Humboldt mountains are often covered with an excellent soil, producing a good grass, and the want of a more luxuriant vegetation can only be explained by atmospheric and similar influences.

The mountains on the west side of the Great Salt lake have their chief geological features in common with those on the east side. A dark limestone belonging to the coal formation, and above it a conglomerate, resting on porphyritic and granitic rocks, in some places on a silicious shale, constitute the materials out of which they are formed. This limestone as well as the conglomerate, or rather remnants of them, are occasionally met with in many other places travelling westward. The former is one of the main rocks constituting the Humboldt mountains, where it overlies granitic masses. In the northern parts of this mountain range the granite passes gradually into quartz, the latter assuming in some places a shaly structure. It is through limestone that the waters of a subterranean creek in the Humboldt mountains have broken an outlet; and both limestone and conglomerate are often found on the summits of the highest peaks of those regions. A soft shaly rock has almost entirely disappeared from that country, and I found remnants of it only in one single place east of the Humboldt mountains; but the clayish soil, over which we had to travel for days, and which contained a number of small pieces of the rock, led to the belief that it extended once far over the country.

The island mountains in the salt desert immediately west of Great Salt lake consist of granitic and porphyritic rocks; the latter is like most of the porphyries we met with, trachytic, its brownish base dissolving under a lens into small grains and broken crystals melted together. It includes numerous crystals of feldspar and grains of quartz, many half an inch thick, and is very hard.

About a mile and a half from the eastern foot of the Humboldt mountains, about camp 19, (1854,) an interesting phenomenon is presented to the view by a number of warm springs—some forty—all of them lying in a circuit of about a hundred yards in diameter. They rise in tubular channels cut through the granite, most of them having a kind of funnel-shaped reservoir on the surface. The smell of the water and a deposit around the springs, show at once that they contain sulphureted hydrogen, and, although quite tasteless when cooled, the water contains, besides the sulphureted hydrogen, a slight proportion of chlorides and sulphates, as shown by chemical test. The temperature of the water on the surface is about 132° Fahrenheit. The spring we found afterwards in Honey Lake valley seems to have the same chemical composition, but its temperature is at the boiling-point.

The mountains lying between the Humboldt mountains and Humboldt river, by our path, are chiefly composed of quartz rocks, trachytic or dioritic porphyry, the above-mentioned dark limestone and conglomerate, and a soft, white, argillaceous or calcareous sandstone. The most remarkable rock in that country, and which deserves a particular mention, is found around the gorge we came through on the 2d of June, and for which I proposed the name of "Agate cañon." This rock is a compact mixture of minerals of the quartz family—agate, chalcedony, and jasper—and is evidently of igneous origin. To the practical arts it would offer a material which for beauty and hardness can hardly be surpassed.

West of Humboldt river we find quartzose rocks, syenites, and granites, and a soft clay-slate, as the predominating rocks; but the nearer we approach to the Sierra Nevada, the more the so-called volcanic rocks take their place, and at last become the only constituent material of the mountains. In Mud Creek cañon, at the foot of the Sierra, we find for the last time a rock which, by its lithological character, is related to the rock I designated as trapp-porphyry, only that it has become shaly or foliating, by the influence of the surrounding volcanic rocks. In the neighborhood of that cañon I found a rock which has all the appearance of standing between this rock and the trachytes of these regions, and which seems to have been formed by the action of these rocks upon each other.

Leaving the cañon wherea conglomerate of igneous rocks crops out from under the above-described shaly trapp, we no longer meet with any older plutonics, or with any sedimentary rocks. Even sandstone, so abundant in the country we before traversed, has disappeared, and the more recent rocks, basalt, phonolithe, ringing beautifully to the hammer, and chiefly trachytes, with a number of intermediate rocks, become masters of the ground. The trachytic rocks seem to be the predominating, if not the only rocks in those parts of the Sierra which we had to traverse when travelling from the headwaters of the Sacramento river down to Honey Lake valley, and which are covered with the most magnificent pine forests.

The highly interesting scenery around the so-called "Black Butte" bears, of all the parts of the Sierra Nevada we passed over, most strikingly the character of a volcanic country. Surrounded by elevated peaks and high cliffs, and quite isolated, stands a mountain, from eight hundred to a thousand feet high, of conical shape, and formed of black lava, apparently a monument of the latest disturbing forces in these regions. The lava is in some degree decomposed at the surface, and the butte, as well as the soil around, is covered with volcanic sand and blocks or small pieces of that lava. In the cliffs on the west side of the butte, the lava passes gradually into trachyte. The summit of this mountain butte is rounded, and no opening in it is perceptible from below.

On the western slopes of the Sierra we find a granitic trachyte, which is distinguished from all other trachytic rocks of the Sierra we met with. It is a reddish gray rough rock, interspersed with crystals of mica, pyroxene—a crystallized mineral, splinters of which melt before the blow-pipe into a pearl, giving out an intense light—and another transparent substance, on which the blow-pipe has no effect, and which, on closer examination, will very likely prove to be a very brittle quartz. The time allowed to this report unfortunately does not admit of a thorough chemical examination, as well of this as some other interesting rocks described above. It would be of the highest scientific interest to know whether these rocks, and chiefly the trachytes of the Sierra Nevada, conform to the law which in the last few years has been established by Bunsen. The great importance of this law, which seems to explain complicated phenomena in a very simple way, and which is not so generally known as it deserves to be, induces me to give a short exposition of it in this report, and to verify it by such analyses as I have been able to make during the limited time allowed for the preparation of this report.

In the fact, established by him experimentally, that the point at which melted substances become solid, varies according to the pressure exercised on these substances, Bunsen expected to find an explanation for the great variety of eruptive rocks, and for the contradictions in the succession of the crystallization of the several mixing substances in relation to their fusibility. The analyses of rocks in the lump, without separating the different simple minerals of which they are composed, which hitherto have been so much neglected, again become important. The analysis of a great number of the characteristic rocks of Iceland, led to the opinion that all these rocks have originated from separate or combined eruptions out of only two independent hearths. One of these hearths furnished the trachytic, the other one the pyroxenic rocks. Their mixing up gave rise to a series of intermediate rocks, which Bunsen called "trachyto-pyroxenic." Great as may be the difference between their ages, mineralogical character, and arrangement, the trachytic and the pyroxenic rocks show a constant average composition, which has only in a few cases been disturbed by local influences, which are easily traced.*

The first of the extreme members of these rocks, the normal trachytic, is a mixture of bisilicates of alumina and bisilicates of alkalies, the oxygen of the acid to that of the basis being as 3 : 0.596. In the other extreme member, the normal pyroxenic, the proportion between the oxygen of the acid and that of the bases (alumina, lime, magnesia, potash, soda, protoxyd of iron,) is 3 : 1.998, or as 3 : 2, almost. They are to be considered a mixture of bibasic silicates. The proportion between silica and magnesia and lime is almost always constant; but that between alumina and protoxyd of iron is subject to great variations, as shown by analysis.

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* Comp. Annual Report by Liebig and Kopp, 1851—1853.

The cause of it is, that such parts as become more easily solid, separate first without the force of crystallization being active. For this reason there are sometimes considerable differences in a rock in short distances. The amount of the variable part changes, however, only slightly. Taking the mean of a great number of analyses, Bunsen gets the composition of the normal trachytic and the normal pyroxenic rocks of Iceland. In the rest, being mixtures of these two, the ratio of the oxygen of the acid to that of the bases varies between the given limits. Their character depends upon these proportions and the physical conditions that ruled their formation. Be S the per cent. of silica in such a mixed rock, be s the per cent. of silica in the normal trachytic, and σ in the normal pyroxenic rock—then $\frac{s-S}{S-\sigma}=a$, where a represents the quantity of normal pyroxenic rock to be mixed with one part of trachytic rock, in order to give the composition of the mixed rock. For the computation of a, B chose the silica, which is easily determined, and by the quantity of silica the quantities of the other parts are also given. Be $p_o, p_1, p_2 \ldots p_n$, the quantities of the single component parts in one part of normal pyroxenic, and t_o, t_1, $t_2 \ldots t_n$, the same in one part of normal trachytic rock, we may then calculate the quantities of the component parts in a mixed rock by the equation—

$$1=\frac{(ap_0+1)}{a+1}+\frac{(ap_1+1)}{a+1}\ldots\ldots+\frac{(ap_n+1)}{a+1}.$$

With the help of this formula all the theoretically possible primitive rocks of Iceland have been calculated and put in tables, and with these theoretical numbers all the analyses of Icelandic rocks agree perfectly; the law holds equally good for the volcanic rocks of Armenia and volcanic rocks generally, and its applicability to the older or plutonic rocks has been put beyond all doubt by the analysis of a great number of granites, sienites, diorites, porphyritic and hornblende rocks, from different countries.

The compositions of the normal trachytic and normal pyroxenic rocks are:

	Norm. trach.	Norm. pyr.
Silica	76.67	48.47
Oxyd of aluminium Protoxyd of iron	14.23	30.16
Oxyd of calcium	1.44	11.87
Oxyd of magnesium	0.28	6.89
Oxyd of potassium	3.20	0.65
Oxyd of sodium	4.18	1.96
	100.00	100.00

The analysis of a rock from the Sierra Nevada, about 40 miles south of Madelin Pass, gave 50.93 per cent. of silica. According to the first of the above formulas, this rock is a mixture of 1 part of normal trachytic and 10.46 parts of normal pyroxenic rock. The second formula gives its composition as—

Silica	50.93
Protoxyd of iron and alumina	28.77
Oxyd of calcium	10.96
Magnesia	6.31
Oxyd of sodium and potassium	3.03
	100.00

The direct analysis gave:

Silica	50.93
Protoxyd of iron and alumina	29.35
Oxyd of calcium	10.33
Oxyd of magnesium.	5.97
Oxyd of sodium and potassium	3.42
	100.00

The following is an analysis of a rock from the headwaters of Pitt river, by Mr. Gustavus Baumgarten, done in my laboratory and under my direction. The determination of silica gave 57.65 per cent.; the rock is a mixture of 1 part normal trachytic, and 2.07 parts of normal pyroxenic rock:

	Composition according to second formula.	Composition found by analysis.
Silica	57.65	57.65
Protoxyd of iron and alumina	24.97	27.56
Oxyd of calcium	8.47	6.58
Oxyd of magnesium	4.74	5.30
Oxyd of sodium and potassium	4.17	2.91
	100.00	100.00

These analyses hardly admit of any doubt as to the applicability of Bunsen's law to the igneous rocks of the Sierra Nevada. It would seem that the hearth of the trachytic masses was lying north, and that of the normal pyroxenic masses more south; a greater number of rocks must, however, be analyzed before we can form a more reliable opinion on that point.

In the Sierra we travelled for days over a red soil, which, according to the popular belief, is gold-bearing. This seems, however, a mistake, produced by the resemblance of its color to that of the soil in the Sacramento valley. It comes from a disintegrated red volcanic rock, of which I found occasionally pieces of six inches in diameter.

There is, however, an auriferous rock, the existence of which in California I find nowhere mentioned, which I found near the summit of one of the high peaks on the Upper Sacramento, (Pitt river.) It is a red rock, with porphyritic structure, and of excessive hardness, bearing unmistakably the signs of gold.

In the rugged Pitt river country, where Canoe creek empties into that river, and a short distance above the mouth of the creek, there is a kind of dam along the creek, made up of a white soil, which, a little remote from the creek, forms a regular stratum of considerable thickness. The rock around is a porphyritic trachyte, and no sedimentary rock of any kind could be detected. On examining this earth under the microscope, I found it to consist of the silicious coats of infusoria, and I therefore sent a specimen of it, together with a specimen of infusorial earth, found in Honey Lake valley, to Professor Bailey, at West Point, as the savan who is best acquainted with American infusoria. According to him they are both made up of diatomaceous shells; some of them are novel, and both are of fresh-water origin, containing many well known species still living all over our country. A fuller description of the new species will be given by Professor Bailey.

I am, sir, very respectfully, your obedient servant,

JAMES SCHIEL, M. D.,
Surgeon and Geologist for Explorations for Central
Pacific Railroad Route.

Lieut. E. G. Beckwith,
3d U. S. Artillery, in charge of Explorations.

List and Description of Organic Remains collected during the Exploration of the Central Pacific Railroad line, by Dr. James Schiel, 1853–'54.

Pl. , Fig. 1.—*Fenestella.* Branches slender, bifurcating, with two rows of pores; sometimes but one row; intervals oval or oblong, with rounded angles, and variable in size.

It occurs with *Productus semireticulatus* and *Productus aequicostatus* in the limestone on Willow creek. It might, perhaps, be referred to Fenest. patula of McCoy.

BRACHIOPODA.

Pl. , Fig. 2, *a, b.*—*Terebratula subtilita.* Hall, Stansbury's expedition to the Great Salt lake, 409 ; Pl. 4, Figs. 1, 2. Gibbous, obovoid, valves nearly equal; beak of the dorsal valve elevated, incurved, perforated at the apex, mesial depression from centre to front; surface marked with concentric striæ and with faint, radiating striæ.

Occurs with *Productus splendens, Spirifer striatus* (?) *Phillipsia,* in the carboniferous limestone about six miles west of Westport. In one specimen the radiating striæ are very distinct.

Pl. , Fig. 3.—*Productus splendens.* Norwood and Pratten. The Producti in the western States, 11; Pl. 1, Fig. 5.

From the same limestone.

Pl. , Fig. 4, *a, b.*—*Productus aequicostatus.* Shumard. Large, elongate, dorsal valve much elevated; beak small, passing slightly beyond the cardinal border; surface covered by longitudinal ribs, which bifurcate near the beak, and then continue without further division to the front, the spaces between being occasionally supplied with new ribs. These ribs are slightly sinuous occasionally, but most of them are straight from their origin to their termination.

Occurs with *Fenestella* and *Productus semireticulatus* in the limestone on Willow creek. I have adopted for this shell the name given to it by Dr. Shumard, who kindly furnished me with the above preliminary description from his manuscript on the palæontology of the State of Missouri. A fuller description, and a drawing of a better and more perfect specimen, will be found in his report.

Pl. , Fig. 5.—*Spirifer,* (indet.) Most likely *Sp. striatus,* yet the specimen is too imperfect for description.

Occurs with *Terebratula subtilita* in the limestone near Westport.

CONCHIFERA.

Pl. , Fig. 6.—*Inoceramus,* (indet.) The specimen is only a cast of inoceramus from a yellowish cretaceous limestone near Fort Atkinson.

Pl. , Fig. 7.—*Inoceramus confertim-annulatus.* Roemer, Kreide. Texas, 59. Transverse, ovate, depressed, with concentric ribs and striæ; the spaces between the ribs hardly equal to their width, and marked with regular, equidistant, elevated lines.

I got this inoceramus in Salt Lake City, as coming from the Upper Green River country. It belongs to the cretaceous period.

Pl. , Fig. 8.—*Inoceramus pseudo-mytiloides.* Inequivalved, elongated, with concentric ribs and striæ; anterior part subtruncated; posterior part slightly compressed, with a wing-like extension of the posterior margin against which the striæ are bending.

It occurs in a gray limestone west of Fort Atkinson. The only difference between this shell and Inoc. mytiloides is the bending out of the striæ.

Pl. , Fig. 9.—*Gryphœa Pitcheri.* Shell thick, expanded, distinctly lobed, lower valve convex, upper valve thick and subconvex ; beak distinctly incurved. (Morton.)

It was found on the top of a sand-hill near Grand river, where it occurs in great abundance, together with impressions of an ammonites. I am indebted for the determination of this shell to Professor Hall, who has several beautiful specimens in his collection.

Pl. , Fig. 10.—*Cardium multistriatum.* Shumard. Exploration of the Red river of Louisiana by Marcy and McClellan, 203; Pl. 4, Fig. 2. Shell subrotund, inflated, length and breadth nearly equal, truncated positively, basal and anterior margin rounded; concentric striæ on the surface.

I was given this shell, with the above Inoceramus confertim-annulatus, as coming from the Upper Green river. It belongs to the cretaceous period.

Pl. , Fig. 11 and Fig. 14. Fig. 11.—*Pygidium* of a *Phillipsia.* A new species, from the limestone near Westport, where it occurs with *Terebratula subtilita*, *Productus splendens*, and apparently two other new species of Productus, of which my specimens are too fragmentary to be described. Fig. 14.—*Phillipsia* from a carboniferous limestone west of Indian creek.

Pl. , Fig. 12.—A piece of limestone from Indian creek, the surface being covered with pieces of stems of a species of encrinites and some bryozoa.

Pl. , Fig. 13.—Impression of an ammonites found with Gryphæ Pitcheri on Grand river.

JAMES SCHIEL, M. D.,
Surgeon and Geologist for Explorations for Central Pacific Railroad.

Names and Localities of various Rocks collected by DR. SCHIEL *during the Explorations of* 1853.

1. Limestone, fossiliferous; near Westport.
2. Limestone; near Willow creek.
3. Limestone; west from Fort Atkinson.
4. Limestone; west from Fort Atkinson.
5. Limestone, upper; bluff near Bent's Fort.
6. Limestone, lower; bluff near Bent's Fort.
7. Sandstone; Apishpa river.
8. Limestone, upper; near the Rocky mountains.
9. Limestone, lower; near the Rocky mountains.
10. Granite; Huerfano butte.
11. Limestone; Huerfano cañon.
12. White silicate; Rocky mountains.
13. Porphyry; Sangre de Cristo Pass.
14. Porphyry; Sangre de Cristo Pass.
15. Gneiss; Sangre de Cristo Pass.
16. Gneiss; Sangre de Cristo Pass.
17. Mica slate; Roubideau's Pass, Sierra Blanca.
18. Quartz rock; Roubideau's Pass, Sierra Blanca.
19. Quartz rock; Roubideau's Pass, Sierra Blanca.
20. Porphyry; Sahwatch butte; Coochetopa Pass valley.
21. Trapp-porphyry; Sahwatch valley.
22. Trapp-porphyry; Sahwatch valley.
23. Granite; Sahwatch valley.
24. Porphyry; Coochetopa Pass.
25. Trapp-porphyry; Coochetopa Creek valley.
26. Black rock; Coochetopa Creek valley.
27. Granite; Grand river.
28. Silicious shale; Grand river.
29. Mica slate; Grand river.
30. Sandstone; Grand river.
31. Fibrous gypsum; Elk mountains.
32. Silicious shale, with agate.

33. Calcareous spar; White river.
34. Red porphyry; Wahsatch mountains.
35. Gray porphyry; Wahsatch mountains.
36. Hyalite; Grand River valley.
37. Oolitic limestone; Wahsatch mountains.
38. Chalcedony; Wahsatch mountains.
39. Red sandstone; Grand river.
40. Greenish argillaceous limestone; Wahsatch mountains.
41. Grayish-yellow foliating limestone; Wahsatch mountains.
42. Crystallized gypsum; Ungot-tah-bi-kin valley.
43. Greenish limestone; Wahsatch mountains.
44. Chalcedony; Wahsatch mountains.
45. Rock from the towery conglomerate on Grand river.
46. Mica slate; Coochetopa Creek valley.
47. Granite; Coochetopa Creek valley.

Names and Localities of various Rocks collected by DR. SCHIEL *during the Explorations of* 1854.

I. Granite; Island mountain, Great Salt Lake Desert.
II. Limestone; Humboldt mountains.
III. Shale; east from Humboldt mountains; remnants of stratum.
IV. Altered trapp-porphyry; Coochetopa creek, 1853.
V. Red porphyry; Goshoot mountains.
VI. Conglomerate; first cañon west of Humboldt mountains.
VII. Dioritic porphyry; west of Agate Pass.
VIII. Chalcedony.
IX. Rock from Agate Pass.
X. Cherty rock; Tuilla valley.
XI. Shale; near Humboldt river.
XII. Red quartz; near Humboldt mountains.
XIII. Rock from Agate Pass.
XIV. Dioritic(?) rock; Humboldt mountains, R. R. Pass.
XV. Dioritic(?) rock; west of Humboldt mountains.
XVI. Shaly rock; west of Humboldt mountains.
XVII. Syenite; foot of Sierra Nevada.
XVIII. Gneiss; foot of Sierra Nevada.
XIX. Argillaceous porphyry; foot of Sierra Nevada.
XX. Lava; Black butte.
XXI. Shaly rock; west of Humboldt mountains.
XXII. Shaly trapp-porphyry; foot of Sierra Nevada.
XXIII. Feldspar (violet and white); foot of Sierra Nevada.
XXIV. Silicious rock; west of Humboldt river.
XXV. Basaltic rock; Sierra Nevada.
XXVI. Porphyritic trachyte; Sierra Nevada.
XXVII. Porphyritic trachyte; summit of Madelin Pass, Sierra Nevada.
XXVIII. Trachyte; between Madelin and Noble's Passes, Sierra Nevada.
XXIX. Trachyte; between Madelin and Noble's Passes, Sierra Nevada.
XXX. Trachyte; between Madelin and Noble's Passes, Sierra Nevada.
XXXI. Trachyte; between Madelin and Noble's Passes, Sierra Nevada.
XXXII. Basaltic(?) rock; west from Humboldt mountains.

XXXIII. Basaltic(?) rock; Mud Creek cañon, Sierra Nevada.
XXXIV. Foliating trapp-porphyry; Mud Creek cañon, Sierra Nevada.
XXXV. Granitic trachyte; west of Black butte.
XXXVI. Lava; near Black butte, Sierra Nevada.
XXXVII. Trachyte; upper waters of Sacramento or Pitt river.
XXXVIII. Black silicious rock; near Humboldt river.
XXXIX. Porphyritic trachyte; Sacramento or Pitt river.
XL. Argillaceous porphyry; Sevier river, 1853.
XLI. Granitic porphyry; Granite mountain, Desert near Great Salt lake.
XLII. Granite; Humboldt mountains.
XLIII. Black shale; Sacramento or Pitt river.
XLIV. Gold-bearing quartz; California; presented by Captain Miller, Quartermaster, United States Army.
XLV. Petrified oak block; Cow creek, California; presented by Captain M. S. Miller, Quartermaster, United States Army.

II.—*Letter from Professor* J. W. Bailey *upon Infusorial Fossils submitted to him by Dr. Schiel.*

West Point, N. Y., *December* 14, 1854.

Dear Sir: I have been requested by Dr. Schiel to send to you some drawings of the fossil Diatoms found by him in California. As I have a considerable amount of matter on hand which claims precedence to this, I have only had time to make the accompanying notes and sketches, which can be disposed of as you may think best.

Specimen No. 1.—*Honey Lake Valley.*

This is a fine, grayish white powder, chiefly composed of Diatomaceous shells, all of which are of fresh-water origin, and probably of recent date. The following are the chief species which I have noticed:

Epithemia, allied to E. Westermanni; several varieties of form, perhaps several species. See Figs. 5, 6.

Cocconema asperum, Ehr.
Cocconema cymbiforme, Ehr.
Discoplea atmosphaerica, Ehr.
Surirella campylodiscus, (?) Ehr. Fig. 4, *a*, *b*.
Cocceneis. Fig. 3.
Cymbella gibba, Bailey. Fig. 1.
Cymatopleura (?) Campylodiscus, Bailey. Fig. 2, *a*, *b*.

The last two species I believe to be new, and they may be characterized as follows:

1. *Cymbella gibba.*—Bailey, (Fig. 1.) Bases somewhat triangular, rounded, and very gibbous on the dorsal side, slightly concave on the ventral side. Length, $\frac{2}{1000}$ of an inch; width, about two-thirds of the length. Locality, Honey Lake valley.

2. *Cymatopleura* (?) *Campylodiscus.*—Bailey, (Fig. 2, *a*, *b.*) Bases circular, or sometimes irregularly bent like a Campylodiscus, marked with one deep transverse undulation. Margins strongly striated. Diameter, $\frac{4}{1000}$ to $\frac{5}{1000}$ of an inch. Locality, Honey Lake valley.

Specimen No. 2.—*Junction of Canoe creek and Sacramento river, California.*

A fine, white powder, chiefly composed of a minute species of Galleinella. (See Fig. .)

It is undoubtedly of fresh-water origin, but contains some circular discs so much resembling the marine Actinocycli, that a mistake as to its origin might easily be made. By careful examination of these discs, however, I have proved them to belong to the genus Stephanodiscus, and have found the crown of thorns preserved on some specimens, although they are commonly broken off. The principal forms I have noticed in this specimen are—

Galleinella (Fig. 7, *a*, *b*) forms chief portion of the mass.
Galleinella varians.
Stephanodiscus—perhaps new.
Pennularia nobilis, Ehr.
Pennularia viridis.
Epithemia, as in No. 1, but comparatively rare.
Surirella splendida (? Ehr.) in fragments.
Pollen of pine.
Spongiolites, which are also present in No. 1.

There are many other fresh-water forms in both specimens, but I have not had time to study them satisfactorily.

Yours, very truly,

J. W. BAILEY.

Lieut. BECKWITH.

APPENDIX.

INSTRUCTIONS FROM THE SECRETARY OF WAR.

War Department,
Washington, February 21, 1854.

Sir: Your letter of the 30th of November to the Chief of the Corps of Topographical Engineers has been, by him, submitted to this department, and the following instructions are given for your government.

You are placed in charge of the party commanded by the late Capt. Gunnison, and will carry out the instructions given him by this department, with the following modifications.

By your letter it appears those instructions had been complied with by Capt. Gunnison previous to his death, with the exception of exploring the Weber river and Timpanogos passes or cañons. You will explore and survey those passes, extending your operations eastward to connect with some well known point, ascertained by previous surveys, to be selected by yourself. You will bear in mind that the object of these explorations is the determination of the most practicable railway route to the Pacific; and that you must obtain a profile of the country traversed, by which it will be practicable to show the gradients of the road: that is to say, you must obtain the data for plotting the courses and distances traversed, and the rise and fall of the ground at intervals wherever decided changes occur in the altitude of the surface of the earth above the level of the sea, or above a point the elevation of which is already known.

After completing the explorations and surveys of the two passes above described, you will retrace your steps and survey the route which you propose, passing to the south of the Great Salt lake, in the direction of the "*Sink*" of Humboldt or Mary's river, thence towards Mud lake and across to the tributaries of Feather river, and thence by the most practicable route to the valley of the Sacramento river; provided that the three conditions hereafter stated can be complied with:

First. If you have money enough left from the sum assigned the late Capt. Gunnison, after completing the surveys already ordered. That amount was $40,000; and a statement from this department is herewith sent you, showing what portion of it had been drawn by Capt. Gunnison at his death.

Second. If, after the completion of the surveys of the Weber river and Timpanogos, you will have remaining, in good condition, the instruments necessary to make the explorations and surveys in the manner which has been described to you as necessary, more particularly the instruments necessary to obtain the data to make the profiles of the country traversed.

Third. Provided you can employ an armed force necessary to supply the place of that which has been removed by the massacre of Capt. Gunnison; and which, in addition to that already employed, and the military escort under command of Capt. Morris, will be sufficient to enable you to make your surveys with security from the Great Basin to the settlements in California.

It is presumed you would not have suggested a survey of the route by Mud lake and Feather river but upon information which leads you to suppose it a practicable one for a railway. If the conditions above stated are complied with, and you make the explorations, Capt. Morris is hereby directed to escort you, and you will make a requisition on him to that effect. On arriving in California you will disband your party, sell your public property, and return by sea, with your assistants, to Washington city.

Should it, however, be determined, by the conditions above stated, not to make the exploration across the Great Basin and the Sierra Nevada, you will extend the exploration of the Weber river and Timpanogos passes eastward to Fort Leavenworth, through the coal basin in the vicinity of Currant creek and Bishop mountain, as delineated on Stansbury's map, or by some route which has not been surveyed. On reaching Fort Leavenworth you will discharge your party and return to this city.

On the receipt of this, you will forward to this department, by the first opportunity, duplicates of all the maps and notes of surveys of the late Capt. Gunnison, and retain the originals until your return to Washington city.

You will, at convenient times, send duplicates of your own notes and surveys to this department.

To enable you to comply with these conditions, you are authorized to draw on this department for twenty-three thousand dollars, the balance unexpended of that portion of the appropriation assigned to the late Capt. Gunnison.

You will not exceed this amount in your expenditures, and you will forward your account to the Colonel of Topographical Engineers.

Very respectfully, your obedient servant,
JEFF'N DAVIS,
Secretary of War.

Lieut. E. G. Beckwith,
U. S. Army, Great Salt Lake City, Utah Territory.

EXPLORATIONS AND SURVEYS FOR A RAILROAD ROUTE FROM THE MISSISSIPPI RIVER TO THE PACIFIC OCEAN.

WAR DEPARTMENT.

REPORT

ON THE

BOTANY OF THE EXPEDITION:

BY

JOHN TORREY AND ASA GRAY.

ROUTE ON THE FORTY-FIRST PARALLEL OF NORTH LATITUDE, UNDER THE COMMAND OF LIEUT. E. G. BECKWITH, THIRD ARTILLERY;

AND

ROUTE NEAR THE THIRTY-EIGHTH AND THIRTY-NINTH PARALLELS OF NORTH LATITUDE, UNDER THE COMMAND OF CAPT. J. W. GUNNISON, CORPS OF TOPOGRAPHICAL ENGINEERS.

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PART II.

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BOTANICAL REPORT.

Botanical Report, by JOHN TORREY *and* ASA GRAY, *upon the Collections made by Captain* GUNNISON, *Topographical Engineers, in* 1853, *and by Lieutenant* E. G. BECKWITH, *Third Artillery, in* 1854.

I.—Plants collected by Mr. James A. Snyder, under the direction of Lieutenant E. G. Beckwith, U. S. A., in an expedition made under his charge from Great Salt Lake, Utah Territory, directly west to the Sacramento valley, in California, in the months of May, June, and July, 1854.

II.—Plants collected by Mr. F. Creutzfeldt, under the direction of Captain J. W. Gunnison, U. S. A., in charge of explorations for a railroad from Fort Leavenworth, *via* the Kansas, Arkansas, and Huerfano rivers, the Sangre de Cristo Pass, San Luis valley, Coochetopa Pass, Grand and Green rivers, and thence into the Great Basin, in the vicinity of the Sevier or Nicollet lake. The collection was made from early in June to late in October, 1853.

PART I.

Plants collected by Mr. JAMES A. SNYDER, *under the direction of Lieutenant* E. G. BECKWITH, *U. S. Army, in an expedition made under his charge from Great Salt lake, directly west, to the Sacramento valley, in California, in the months of May, June, and July*, 1854.

AQUILEGIA CANADENSIS, *Linn.; Torrey and Gray, Fl.* 1, *p.* 29. In a cañon east of the Sierra Nevada; June 17. Few phanerogamous plants of this country have so great a geographical range as has this species, (including the A. formosa, *Fischer*,) namely: from Hudson's Bay to Florida and New Mexico, and from Unalaschka to California.

DELPHINIUM MENZIESII, *DC. Syst.* 1, *p.* 355; *Hook. Fl. Bor.-Amer.* 1, *p.* 25. Near Great Salt Lake. Also, in a valley of the Sierra Nevada; with an incomplete specimen of what may be a white-flowered variety; May and June.

ESCHSCHOLTZIA CALIFORNICA, *Cham. and Nees, Flor. Phys. Berol. p.* 73, *t.* 15, *non Lindl.* Sierra Nevada; June 25.

TURRITIS RETROFRACTA, *Hook. Fl. Bor.-Amer.* 1, *p.* 41. Summit of a mountain in the Great Basin east of the Sierra Nevada. In flower only; June 1.

ERYSIMUM ASPERUM, *DC.; Torr. and Gray, Fl.* 1, *p.* 95. Mountains near Great Salt Lake; May.

SPRAGUEA UMBELLATA, *Torr. Pl. Fremont, in Smithson. Contrib. p.* 4, *t.* 1. Summit of Noble's Pass, Sierra Nevada; July 3. The specimens of this interesting Portulacaceous genus accord with those of Col. Fremont, who alone has gathered the plant hitherto; but being younger, the corollas are more conspicuous, and the scarious sepals not so large.

LEWISIA REDIVIVA, *Pursh, Fl.* 1, *p.* 368; *Hook. and Arn. Bot. Beech. p.* 334, *t.* 86. On the Sierra Nevada; June 25.

SIDALCEA MALVÆFLORA, *Gray, Pl. Wright.* 1, *p.* 16. Mountains east of the Sierra Nevada; June 14.

VIOLA BECKWITHII, (n. sp.): subcaulescent; ascending stems abbreviated; cauline leaves biternately or pedately parted, decurrent on the margined petiole, the lobes or segments oblong-linear, hirsute-puberulent; stipules minute, scarious, entire; sepals linear, obtuse, ciliolate; lower petal barely saccate at the base, purple, with yellow claws, the two upper shorter and deep violet. On the slope of a mountain between Great Salt Lake and the Sierra Nevada;

June 1. A well-marked species; with the foliage somewhat like that of V. delphinifolia, *Nutt.;* but the primary divisions compoundly divided in a ternate or pinnatisect manner; and there is a distinct stem, although it is only an inch long in the specimen. Lobes of the leaves half an inch or less in length. Stipules very small and inconspicuous, except those of the lowest and subradical leaves, which are larger. Peduncles 2 inches, naked. Petals half an inch long. Style short, clavate, minutely bearded at the gibbous summit; the stigma lateral.

TRIFOLIUM ALTISSIMUM, *Dougl. in Hook. Fl. Bor.-Am.* 1, *p.* 130, *t.* 48. On the Sierra Nevada; June 22.

ASTRAGALUS (PHACA) PURSHII, *Dougl. in Hook. Fl. Bor.-Am.* 1, *p.* 152. Phaca mollissima, *Nutt. in Torr. and Gray, Fl.* 1, *p.* 350; *Torr. in Stansbury's Rep. p.* 385, *t.* 3, *figs.* 4 and 5. Near Humboldt river; in fruit. In reuniting Phaca to Astragalus, the name given by Douglas to this species is to be restored, both on account of its priority, and because there is already an Astragalus mollissimus.

ASTRAGALUS (PHACA) UTAHENSIS: caespitose, very softly and densely white-tomentose; stems short and depressed; leaflets 6–9 pairs, broadly obovate or nearly orbicular; stipules lanceolate, subulate-pointed, free; peduncles equalling or exceeding the leaves, subcapitately 3–6-flowered; bracts setaceous, twice the length of the pedicels; teeth of calyx subulate, much shorter than the cylindrical tube; corolla violet-purple; legumes extremely woolly, sessile, oblong, pointed, incurved, strictly one-celled. Phaca mollissima β. Utahensis, *Torr. in Stansb. Rep. p.* 385, *t.* 2. Near Lone Rock, south of Great Salt Lake. In flower; May. Although closely allied to the preceding, this may safely be considered as a distinct species; and so Dr. Torrey was inclined to regard it. A. Purshii, besides its oblong and often acute or acutish leaflets, has the foliage and calyx, &c., clothed with villous or shaggy hairs, so that Hooker describes it as "hirsutissimus," and the flowers are said by Douglas to be yellow, meaning doubtless ochroleucous, except a purple tip to the keel. The present plant is white, with a soft and matted tomentum, and the corolla is violet-purple. The mature pods, (here described chiefly from a fruiting plant gathered by Captain Stansbury, which is doubtless a form of the species, though with shorter peduncles,) after detaching the thick mass of wool in which they are imbedded, are found to be narrower, but otherwise similar to those of the preceding. In the figure above cited, the tube of the calyx is mostly represented quite too short. It is really of the same elongated form as in A. Purshii, but the teeth are not so setaceous.

ASTRAGALUS (HOMALOBUS?) BECKWITHII, (n. sp.): glabrous or nearly so, low, perennial; stems branched from the base, ascending; stipules triangular-lanceolate, nearly free; petioles slender; leaflets 6–9 pairs, small, oval-orbicular, rather scattered; peduncles about the length of the leaves, 7–8-flowered; bracts subulate, small; calyx oblong-campanulate, sparsely and minutely black-haired; the aristiform-subulate teeth nearly as long as the tube; corolla ochroleucous, incurved, the oblong vexillum deeply emarginate; ovary linear, stipitate. On the Cedar Mountains, west of Lone Rock, and south of Great Salt Lake; May; in flower. The slender stems, with the peduncles that terminate them, are only 4 inches long in the specimen, and not exceeding the radical leaves; but as they go on to branch they doubtless attain a considerably greater height in the season. Leaflets 2½ or 3 lines long, slightly petiolulate, rather fleshy in texture, veinless, glabrous, except some minute hairs on the midrib and margins when first developed. Flowers crowded on very short pedicels; tube of the calyx 3 lines long; corolla 9 lines long, abruptly curved near the obtuse tip of the keel, which is much shorter than the wings and vexillum; ovary glabrous, more or less compressed, many-ovuled, neither suture at all introflexed, raised on a stipe which is soon about as long as the tube of the calyx. The fruit, unfortunately, is still unknown; but the plant is evidently one not before described.

ASTRAGALUS DIPHYSUS, *Gray, Pl. Fendl. p.* 34? Southwest of Great Salt Lake; May. In flower only, and not to be accurately determined.

Lupinus affinis, *Agardh, Syn. Lup. p.* 20; *Torr. and Gray, Fl. p.* 376. Agate Pass of the Quartz Mountains; June 1.

Lupinus decumbens, var. argophyllus, *Gray, Pl. Fendl. p.* 38. Utah, in a cañon; May 29. Flowers yellow and white. This is the same as Fendler's No. 167, and is very likely Pursh's L. argenteus. L. laxiflorus, perhaps, runs into it. The calyx is conspicuously saccate-spurred on the upper side.

Rosa gymnocarpa, *Nutt. in Torr. and Gray, Fl.* 1, *p.* 461. On the Sierra Nevada; July.

Œnothera marginata, *Nutt. in Torr. and Gray, Fl.* 1, *p.* 500. On the summit of the Humboldt Mountains, Utah; May.

Œnothera (Chylismia) clavæformis, *Torr. in Frem. Rep.* 2*d Exped. p.* 314. At the foot of the Sierra Nevada, on the eastern side; June. What appears to be a cinereous and somewhat hairy, more caulescent, and branching variety of this, was gathered by Coulter: No. 180 of his California collection.

Œnothera (Sphærostigma) alyssoides, *Hook. and Arn. Bot. Beech. p.* 394; *Hook. Ic. Pl. t.* 339. Near Humboldt river; June. Flowers white.

Œnothera (Primulopsis) tanacetifolia (n. sp.): stemless, perennial? minutely pubescent; leaves lanceolate in outline, interruptedly pinnately parted into very numerous small segments, some of them minute and oval or oblong, the others linear; all sinuate-toothed or pinnatifid; tube of the calyx shorter than the leaves, filiform, dilated at the summit; the segments lanceolate, shorter than the obovate petals and the style; anthers oblong, much shorter than the moderately unequal filaments; stigma discoid, entire. On the higher parts of the Sierra Nevada; June 18. Root apparently thick and perennial. Leaves 3 or 4 inches long, including the short petiole, 5 to 8 lines wide, finely dissected. Tube of the calyx 2 inches or more in length; the segments half an inch long. Petals bright yellow, nearly an inch long. Stigma broad and flat. Fruit not seen.

Œnothera (Godetia) rubicunda, *Lindl. Bot. Reg. t.* 1856. In the Sierra Nevada; June.

Peucedanum nudicaule, *Nutt. in Torr. and Gray, Fl.* 1, *p.* 627, var. ellipticum. Minutely and softly pubescent; fruit narrowly elliptical, nearly three times as long as broad, the winged margin as wide as the disk. Round Valley, near the sources of the Sacramento, in the Sierra Nevada; June 27. Intermediate between P. nudicaule and P. macrocarpum, having exactly the foliage of the former and the fruit of the latter. The roots of this species are used as food by the natives.

Peucedanum triternatum, *Nutt. in Torr. and Gray, Fl. l. c.* Seseli biternatum, *Pursh, Fl.* 1, *p.* 197; *Hook. Fl. Bor.-Amer.* 1, *p.* 304, *t.* 94. Sierra Nevada. The roots of this plant, in a dried state, were brought home by Lieutenant Beckwith. They are about the size of "peanuts," and are collected very largely by the Indians. When dried they are hard but brittle, and have a mild sweet taste. They afford a good proportion of the food of some tribes. Besides a large quantity of starch, they contain much other nutritious matter.

Cymopterus montanus, *Nutt. in Torr. and Gray, Fl.* 1, *p.* 624; *Gray, Pl. Fendl. p.* 67. Summit of the Goshoot Mountain, Central Utah. In the solitary specimen which the collection contained, the flowers are in a singular abnormal condition. The upper part of the ovary is furnished with ten spongy wings, which extend beyond the flower. The stamens are reduced to rudiments. The teeth of the calyx are normal. Instead of five petals there are only two or three, and these are of an unusual form. The styles are conspicuous, but seem to be destitute of stigmas.

Chænactis stevioides, *Hook. and Arn. Bot. Beech. p.* 371. Foot of the Sierra Nevada, on the eastern side; June.

Layia glandulosa, *Hook. and Arn. Bot. Beech. p.* 358. Eastern side of the Sierra Nevada; June. Rays white.

Tetradymia glabrata (n. sp.): shrubby, divaricately branched, unarmed, young branchlets, and foliage loosely clothed with floccose white wool, which is soon deciduous; leaves subulate or acerose, rather fleshy; the primary ones erect (none of them converted into spines); the secondary ones crowded in axillary fasciales, glabrous; scales of the tomentose-canescent involucre and flowers four; hairs of the achenium much shorter than the barbellate-denticulate bristles of the pappus. On the Sierra Nevada, June 16. This is distinguished from T. Nuttallii by the acerose, terete, or angled and fleshy leaves, mostly mucronate or pointed, and glabrous, or soon glabrate: from T. spinosa (which it resembles in the secondary leaves) by the fewer flowers and involucral scales, the hairs of the ovarium much shorter than the pappus, &c.; and from both of the entire want of spines. It belongs to Tetradymia proper.

Dodecatheon integrifolium, *Hook. Fl. Bor.-Am.* 2, *p.* 118; *and Bot. Mag. t.* 3622. In a cañon between Salt Lake and the Sierra Nevada; May.

Phlox canescens (n. sp.): dwarf, very much branched, and densely caespitose, tomentose when young, and canescent; leaves acerose, imbricated, at length recurved-spreading, not rigid, very woolly towards the base, the lower ones marcescent; flowers sessile; teeth of the calyx similar to the leaves, and fully as long as the woolly tube; tube of the corolla much longer than the calyx and the cuneiform obovate retuse lobes. P. Hoodii, *Torr. in Stansb. Exped. p.* 304. On the Cedar Mountains, south of the Great Salt Lake. This species (of which badly preserved specimens were also gathered by Colonel Fremont, in his second expedition) is allied to P. Hoodii and P. Douglasii. From the former it is distinguished by its more slender leaves and calyx-lobes, and much longer corolla; from the latter (which has longer calyx-teeth than is shown in Hooker's figure) it is distinguished by its woolliness, its less rigid foliage, longer calyx-lobes, and smaller corolla, but with the tube proportionally longer. The ovules are solitary in each cell. The limb of the corolla appears to be white; its tube yellowish.

Gilia pulchella, *Dougl. in Hook. Fl. Bor.-Amer.* 2, *p.* 74. At the foot of the Humboldt Mountains, on the eastern side; May.

Phacelia integrifolia, *Torr. in Am. Lyc. Nat. Hist. N. Y.* 2, *p.* 222, *t.* 3. Valley of Humboldt River, Utah; June 8.

Phacelia humilis (n. sp.): annual, low, much branched from the base; leaves oblong, spatulate or lanceolate, all simple and entire, indistinctly veined, minutely hirsute-pubescent like the branches, and glandular dotted; racemes densely-flowered; segments of the calyx linear, obtuse, hispid, a little shorter than the (deep violet-colored) corolla; stamens exerted. Near the summit of the Sierra Nevada, California; June. A well-marked species, three or four inches high, somewhat cinereous, with a fine pubescence, except the inflorescence, and especially the calyx, which is hispid with rigid white hairs. Leaves an inch or less in length, short-petioled. Corolla short, when expanded three lines in diameter; the base biplicate between the stamens. Filaments sparingly hispid above. Style glabrous. Ovules two in each cell. Capsule 2–3-seeded. This can hardly be the P. canescens of Nuttall, in Pl. Gambell., which accords better with some states of P. circinata.

Scrophularia nodosa, *Linn.; Benth. Pl. Hartweg. no.* 1877. Foot of the Sierra Nevada; June. The leaves are smaller, much truncate at the base, and more laciniate-toothed than the plant of the Atlantic States.

Collinsia parviflora, *Dougl. in Lindl. Bot. Reg. t.* 1802. Foot of the Humboldt Mountains; May.

Pentstemon speciosus, *Dougl. in Lindl. Bot. Reg. t.* 1270. Mountains in the western part of Utah; June.

Pentstemon heterophyllus, *Lindl. Bot. Reg. t.* 1899? Sierra Nevada, California, on the summit of the mountains; June. Two forms, if not species, have been merged by Hooker and

Arnott under P. heterophyllus. The present single specimen resembles the var. *α*, in the narrow and marginless sepals, and in the smaller flowers; but the peduncles are principally three-flowered. Not improbably it belongs to an entirely different species.

PENTSTEMON HETERANDRUM (n. sp.): glabrous; stem slender, virgate; leaves lanceolate or oblong-linear, obtuse, callose-serrulate, obtuse or subauriculate at the base; panicle spicate, interrupted; cymes subsessile, several-flowered; calyx puberulous, the segments ovate-lanceolate; corolla (nearly white) infundibuliform, slightly gibbous above, with 5 short subequal lobes, in æstivation various; stamens glabrous, straightish, of nearly equal length, all antheriferous, or the fifth without an anther. Sierra Nevada, California; June 30. Flower white, with pink lines half an inch in length. Cauline leaves an inch long, and 3 lines wide; the floral ones successively reduced to small bracts. Anthers glabrous; the cells distinct, moderately diverging. Stigma minute and simple. Ovary, &c., apparently as in Pentstemon. Fruit not seen. Two peculiarities are to be noticed in this remarkable plant, either of which would have been sufficient to exclude it from Pentstemon, but both prove to be inconstant in the species. One of these relates to the stamens, which, in the flowers examined, were perhaps more frequently completely *pentandrous* than otherwise; the fifth (posterior) filament being similar to the others, and bearing either an exactly similar anther, or sometimes one with rather smaller cells, and with the filament or connective prolonged into a short and blunt apical appendage, as shown in figures 9 and 10. In some flowers, however, this anther was found to be reduced to a single and rather imperfect cell, and a bare rudiment of the second cell, as in fig. 11; in others again, (as in fig. 12 and fig. 6,) the fifth stamen is wholly destitute of any trace of anther, as in Pentstemon universally, with this exception, if such it be. It is also to be noted that the stamens of this plant are nearly equal in length, at least when all five are antheriferous, and that they are inserted into the very base of the corolla. The remaining peculiarity relates to the æstivation of the corolla; in which, although some of the flower-buds plainly have the two posterior lobes, or one of them, exterior to the others, in the manner of the Antirrhinideæ generally, (this being, indeed, the only absolute character of that suborder), as shown in figures 3 and 4; yet, in quite as many instances we find the lateral lobes exterior in the bud, and covering the two posterior as well as the anterior, (as is represented in figure 2), in the manner of the Rhinanthideæ: a new and striking instance of the instability of the modes of æstivation of the corolla, and one not altogether unexpected, since Mr. H. T. Clark, a former pupil of Dr. Gray, and an acute and zealous naturalist, showed him several years ago that both modes occur in Mimulus ringens, M. moschatus, &c.

MIMULUS LUTEUS, *Linn.* In the Sierra Nevada; June.

CASTILLEJA HISPIDA, *Benth. in Hook. Fl. Bor.-Amer.* 2, *p.* 105. Cedar Mountains, south of Great Salt Lake; May.

CASTILLEJA PALLIDA, *Kunth.* Foot of the Humboldt Mountains, on the eastern side; May.

AUDIBERTIA INCANA, *Benth. in Bot. Reg. t.* 1469; *and in DC. Prodr.* 12, *p.* 359. On the Sierra Nevada; June 20. Flowers blue.

MONARDELLA ODORATISSIMA, *Benth. Lab. p.* 332; *and in DC. Prodr.* 12, *p.* 190. *β.* GLABRIUSCULA; nearly glabrous; branches slender; leaves oblong-lanceolate, narrowed to a petiole at the base, rather acute; heads terminal; bracts ovate, (colored,) shorter than the calyx, rather acute; teeth of the calyx ovate-lanceolate, acute, unarmed. Sierra Nevada; July 8. Differs from M. odoratissima in its larger and conspicuously petiolate leaves, and in the narrower acutish bracts, &c. Flowers rose-colored.

Most of the species of this genus have the narrow lobes of the corolla sacculate at the apex; a character which seems to have escaped the notice of Mr. Bentham.

MERTENSIA OBLONGIFOLIA, *G. Don, Syst. Gard.* 4, *p.* 372; *DC. Prodr.* 10, *p.* 92. Pulmonaria oblongifolia, *Nutt. in Journ. Acad. Phil.* 7. *p.* 13. Pass in Humboldt Mountains; May 23. Flowers blue. This species was found also in various parts of Utah, by Colonel Fremont.

Eritrichium glomeratum, *DC. Prodr.* 10, *p.* 131. Myosotis glomerata, *Nutt. Gen.* 1, *p.* 112; *Hook. Fl. Bor.-Amer.* 2, *p.* 82, *t.* 162. Summit of Humboldt Mountains; May 27.

Echinospermum floribundum, *Lehm. Pug.* 2, *p.* 24; *Hook. Fl. Bor.-Amer.* 2, *p.* 84 *t.* 164; *DC. Prodr.* 10, *p.* 143. Summit of Humboldt Mountains; May 27. Corolla white, finely veined with blue.

Grayia polygaloides, *Hook. and Arn. in Hook. Ic. t.* 271 *and* 388; *Bot. Beech. p.* 387. G. spinosa, *Moq. in DC. Prodr.* 13, *pars* 2, *p.* 119. Chenopodium (?) spinosum, *Hook. Fl. Bor.-Amer.* 2, *p.* 127. Eastern base of the Sierra Nevada; June 15, (in fruit.) This shrub is called *Greasewood* by the hunters.

Eurotia lanata, *Moq. Chenop. p.* 81; *and in DC. Prodr.* 13, *pars* 2, *p.* 121. Diotis lanata, *Pursh, Fl.* 2, *p.* 602; *Nutt. Gen.* 2, *p.* 206. Eastern base of the Sierra Nevada; June 15. Flowers monoecious and dioecious. Sepals of ♂ ovate, or rather acute. Moquin (l. c.) asks whether the ♀ flowers are not bibracteate and destitute of a calyx. This is no doubt their true structure, and is the view taken of them by Ledebour, (*Fl. Ross.* 3, *p.* 737.)

Eriogonum ovalifolium, *Nutt. in Journ. Acad. Sc. Phil.* 7, *p.* 51, *t.* 8, *fig.* 1. Eucycla ovalifolia, *Nutt. l. c.* (*n. ser.*) 1, *p.* 166. Eastern base of the Sierra Nevada; June 15. In our solitary specimen there is but a single scape, which is about seven inches high. The leaves are broader than in Nuttall's plant. The filaments are scarcely one-third the length of the sepals, and woolly.

Eriogonum cernuum, *Nutt. in Journ. Acad. Sc. Phil.* (*new ser.*) 1, *p.* 162, *β.* purpurascens. Eastern base of the Sierra Nevada; June 16. Leaves sometimes almost reniform-orbicular. Scape sparingly and trichotomously branching an inch or two above the base. Peduncles purplish, and involucres glandularly pubescent. Sepals deep rose-color, with pale margins, the exterior ones somewhat retuse, much longer and broader than the inner ones. Filaments shorter than the inner sepals, glabrous. Achenium with a long acuminate point. Embryo curved, the radicle elongated, erect. Differs from the ordinary form of E. cernuum, which is much more branched, and has white flowers.

Rumex venosus, *Pursh, Fl.* 2, *p.* 733; *Nutt. Gen.* 1, *p.* 240; *Hook. Fl. Bor.-Amer.* 2, *p.* 130, *t.* 174. Mountains in Central Utah, May 12.

Amianthium Nuttallii, *Gray, in Ann. Lyc. N. York*, 4, *p.* 123. Helonias augustifolia, *Nutt. in Trans. Amer. Phil. Soc.* (*n. ser.*) 5, *p.* 154. Amiantanthus Nuttallii, *Kunth*, 4, *p.* 181. Foot of Oquirrh Mountain, south end of the Great Salt Lake; May 6.

Sisyrinchium grandiflorum, *Dougl. in Bot. Reg. t.* 1364; *Bot. Mag. t.* 3509; *Hook. Fl. Bor.-Am.* 2. *p.* 207. Pass of Humboldt Mountain; May 23.

Iris longipetala, *Herbert in Hook. and Arn. Bot. Beech. p.* 395. Fort of Humboldt Mountains on the east side; May 28.

Camassia esculenta, *Lindl. Bot. Mag. t.* 1486; *Kunth. Enum.* 4, *p.* 347; *Torr. and Gray in Whipple's Report, ined.* Phalangium Quamash, *Pursh, Fl.* 1, *p.* 226. Near the summit of the Sierra Nevada; June 18.

Calochortus Nuttallii: stem 2-flowered; leaves very narrowly linear; petals obovate-cuneate, rounded at the summit (white, but yellow at the base), with an oblong dense tuft of hairs on the claw; and just above this a purple spot, with a few scattered hairs. C. luteus, *Nutt. in Journ. Acad. Philad.* 7, *p.* 51, *not of Dougl.* Summit of Noble's Pass, Sierra Nevada; July 3. We have little doubt of this being Nuttall's C. luteus, as it agrees exactly with his description, and with an imperfect but original specimen of that plant, except that the flower, according to Snyder, is white. Mr. N. was uncertain of the color of the flower in his specimen, for he says they are "apparently sulphur yellow." They are, indeed, yellow at the base even in the dried plant, and Mr. Nuttall supposed they were wholly of that color in the fresh state. The marking and other characters of the petals are unlike those of Douglas's C. luteus; and as his plant was first discovered, and probably first described, the name must be retained for it. Besides, the name given to it by Mr. Nuttall is inappropriate, if, as we feel pretty confident, the flower of his plant is white.

Brodiæa grandiflora, *J. E. Smith in Linn. Trans.* 10, *p.* 3; *Kunth, Enum.* 4, *p.* 471. Scape glabrous; umbel, few-(8–12-) flowered; the rays usually 2–4 times longer than the flowers; abortive stamens linear, emarginate, and often also mucronate; cells of the ovary about 10-ovuled. Madelin Pass of the Sierra Nevada; June 26.

Brodiæa parviflora, n. sp.: scape roughish; umbel, many-(15–20-) flowered; pedicels shorter than the flower; sterile stamens ovate-lanceolate, rather acute, entire; cells of the ovary 6–8-ovuled. With the preceding; June 26. Bulb ovate, sometimes more than an inch in diameter. Leaves all radical or nearly so, rather shorter than the scape, about two lines wide, smooth. Scape scarcely larger than a crow-quill, the upper part somewhat flexuous, terete, scabrous with very minute points. Umbel about an inch and a half in diameter; pedicels unequal, most of them scarcely half the length of the flowers. Involucrate bracts, 4–8, colored, about as long as the pedicels, the outer ones ovate and acuminate. Flowers about half an inch long, pale purple, the tube somewhat inflated; segments erect, ovate, rather acute. Fertile stamens 3, inserted at the upper part of the tube of the perianth, opposite the inner segments; anthers linear-oblong, acute at each end. Style filiform; stigma dilated, 3-lobed, the lobes fimbrillate-papillose. We have long had specimens of this plant, collected by Colonel Fremont on Prevost's Fork of the Utah; and others brought from the valley of the Sacramento by Dr. Stillman. It is easily distinguished from B. grandiflora by the characters given above.

Pteris Aquilina, *Linn.; Torr. Fl. N. York*, 2, *p.* 488. On the Sierra Nevada.

PART II.

Plants collected by Mr. F. Creutzfeldt, *under the direction of Captain* J. W. Gunnison, *U. S. Army, in charge of explorations for a railroad from Fort Leavenworth, by the way of the Kansas and Arkansas rivers, to Bent's Fort; thence by the Huerfano river and Sangre de Cristo Pass to the valley of San Luis; thence west from that valley to Grand and Green rivers; thence into the Great Basin, Utah, to the vicinity of the Sevier or Nicollet lake. The collection was commenced at Westport, in Missouri, in June,* 1853, *and finished late in October.*

[The Rocky mountain ranges were entered early in August. The Sierra Blanca, in which the Sangre de Cristo and Roubideau's passes are found, forms the eastern range of the Rocky mountains, and (at the head of San Luis valley, New Mexico) unites with the next western range, which is known as the Sierra San Juan or Sahwatch chain. This sierra, in turn, is joined around the head of Grand river to Elk mountain, and this again to the Roan mountains, the latter being only separated from the former by Blue river, which breaks through in a cañon; and the Roan mountains themselves are separated from the Wahsatch mountains only by the entirely similar cañon passage of Green river, which also breaks through the great east and west connecting range known as the Uinta mountains. All of these ranges, some more or less parallel, while others form cross and connecting chains, constitute properly the great mountain formation of the continent, to which the name of Rocky mountains is applied; the former names applying only to the subdivisions of this great feature.]

Anemone Virginiana, *Linn.* Prairies beyond Westport, in Kansas Territory.

Clematis Pitcheri, *Torr. and Gray, Fl.* 1, *p.* 10. Prairies between Westport and Cottonwood Creek.

Thalictrum Cornuti, *Linn.* Beyond Westport, in Kansas.

Ranunculus divaricatus, *Schrank; Gray, Pl. Wright*, 2, *p.* 8. Kansas.

Delphinium azureum, *Michx.* Beyond Westport.

Menispermum Canadense, *Linn.* With the preceding.

Argemone Mexicana, *Linn.* var. albiflora, *DC.* Walnut Creek.

THELYPODIUM INTEGRIFOLIUM, *Endl. in Walp. Repert.* 1, *p.* 172. Pachypodium integrifolium, *Nutt.; Hook. and Arn. Bot. Beech. pp.* 321 *and* 74. Coochetopa, Sierra San Juan. In flower. "Flowers reddish purple."

THELYPODIUM WRIGHTII, *Gray, Pl. Wright,* 1, *p.* 7 *and* 2, *p.* 12. In the Rocky Mountains. The specimens resemble Wright's No. 845.

CLEOME LUTEA, *Hook. Fl. Bor.-Am.* 1, *p.* 70, *t.* 25. C. aurea, *Nutt. in Torr. and Gray, Fl.* 1, *p.* 122. Sand-banks of Green River, Utah.

PARNASSIA PARVIFLORA, *DC. Prodr.* 1, *p.* 320; *Hook. Fl. Bor.-Am.* 1, *p.* 82, *t.* 27. Rocky Mountains, in the valley of the Grand River; August. This accords with specimens from the northwest coast, and with Hooker's figure (which is not cited in Torr. and Gray, Fl.) but is still more delicate and slender. The filiform scape is five or six inches long; the petals three lines long; the radical leaves less than half an inch long, but abrupt at the base, shorter than their petiole.

SILENE STELLATA, *Ait.* Upper Arkansas.

ARENARIA FENDLERI, *Gray, Pl. Fendl. p.* 13. Rocky Mountains, near the head of the Rio Grande; August. Resembling Fendler's plant, but not so tall.

PARONYCHIA JAMESII, *Torr. and Gray, Fl.* 1, *p.* 170. Plains near Fort Atkinson.

CALLIRRHÖE INVOLUCRATA, *Gray, Pl. Fendl. p.* 16. Prairies near Bluff Creek.

SIDALCEA MALVÆFLORA, *Gray, Pl. Wright.* 1, *p.* 16. Utah Creek; August.

SIDALCEA CANDIDA, *Gray, Pl. Fendl. p.* 24. In the Rocky Mountains, east of the Rio Grande; August. In flower.

SPHÆRALCEA ANGUSTIFOLIA, *Cav.* var. S. STELLATA, *Torr. and Gray, Fl.* Sandy banks of the Arkansas, near the Rocky Mountains.

CEANOTHUS AMERICANUS, *Linn.* Beyond Westport, near the Arkansas River.

POLYGALA ALBA, *Nutt.* Beyond Walnut Creek; July.

PSORALEA OBTUSILOBA, *Torr. and Gray, Fl.* 1, *p.* 300. Kansas; June.

AMORPHA CANESCENS, *Nutt. Gen.* 2, *p.* 92. Between Westport and Bent's Fort.

DALEA LAXIFLORA, *Pursh, Fl.* 2, *p.* 741. Near Walnut Creek; July.

PETALOSTEMON VIOLACEUM, *Michx. Fl.* 2, *p.* 50, t. 37. With the preceding.

PETALOSTEMON CANDIDUM, *Michx. l. c.* With the preceding species.

OXYTROPIS LAMBERTI, *Pursh, Fl.* 2, *p.* 740. Two varieties: one with pale, and the other with violet purple flowers. Rocky Mountains.

ASTRAGALUS ADSURGENS, *Pall.; Hook. Fl. Bor.-Am.* 1, *p.* 149. Rocky Mountains; August.

BAPTISIA LEUCANTHA, *Torr. and Gray, Fl.* 1, *p.* 385. Arkansas River; June.

HOFFMANSEGGIA JAMESII, *Torr. and Gray, Fl.* 1, *p.* 393. Near Fort Atkinson; July.

SCHRANKIA UNCINATA, *Willd.; Torr. and Gray, Fl.* 1, *p.* 400. Upper Arkansas.

RUBUS DELICIOSUS, *Torr. in Am. Lyc. Nat. Hist. N. York,* 2, *p.* 196. Rocky Mountains. Leaves only.

ŒNOTHERA SPECIOSA, *Nutt. in Journ. Acad. Philad.* 2, *p.* 119. Beyond Westport.

ŒNOTHERA SERRULATA, *Nutt.* var. DOUGLASSII, *Torr. and Gray, Fl.* 1, *p.* 502. Beyond Walnut Creek.

STENOSIPHON VIRGATUS, *Spach, Onagr. p.* 64.

GAURA SINUATA, *Nutt.* Near Fort Atkinson.

GAURA COCCINEA, *Nutt. Gen.* 1, *p.* 249. Walnut Creek.

EPILOBIUM ANGUSTIFOLIUM, *Linn.* Common in the Rocky Mountains.

LYTHRUM ALATUM, *Pursh; Torr. and Gray, Fl.* 1, *p.* 481. From Westport to Walnut Creek.

Mentzelia (Bartonia) nuda, *Torr. and Gray, Fl.* 1, *p.* 534. Near Fort Atkinson; July.

Cryptotænia Canadense, *DC. Prodr.* 4, *p.* 119. Beyond Westport; June.

Thaspium cordatum, *Torr. and Gray, Fl.* 1, *p.* 615. Near Westport; June.

Conioselinum Canadensis, *Torr. and Gray, Fl.* 1, *p.* 619. In the Rocky Mountains; August. In flower only.

Galium concinnum, *Torr. and Gray, Fl.* 2, *p.* 23. Beyond Westport, Arkansas River; June.

Galium boreale, *Linn.* In the Rocky Mountains; August.

Oldenlandia angustifolia, *Gray, Pl. Wright.* 2, *p.* 68. Beyond Westport; June.

Brickellia grandiflora, *Nutt. in Trans. Amer. Phil. Soc.* (*n. ser.*) 7, *p.* 287. Rocky Mountains; August.

Aster multiflorus, *Ait.* Utah Creek; August.

Machæranthera tanacetifolia, *Nees; Gray, Pl. Wright, 1, p.* 90. Fort Atkinson.

Erigeron glabellum, *Nutt. Gen.* 2, *p.* 147; *Torr. and Gray, Fl.* 2, *p.* 173. Utah Creek; August.

Townsendia Fendlerii, *Gray, Pl. Fendl. p.* 70. Valleys in the Rocky Mountains; August.

Coreopsis palmata, *Nutt. Gen.* 2, *p.* 180. Arkansas River.

Gaillardia pulchella, *Foug.; Torr. and Gray, Fl.* 2, *p.* 366. Beyond Walnut Creek; July.

Actinella lanata, *Nutt. Trans. Amer. Phil. Soc.* 7, *p.* 380. White River Mountains, Utah; October. The leaves are nearly smooth, and strongly punctate; awn of the pappus half as long as the scale. Seems about intermediate between this species and *A. Torreyana*, Nutt.

Artemisia filifolia, *Torr. in Ann. Lyc. N. York,* 2, *p.* 211. Sand-banks of Green River, Utah; October.

Artemisia discolor, *Dougl.; Besser; DC. Prodr.* 6, *p.* 109. Roubideau's Pass, Rocky Mountains; Sierra Blanca.

Antennaria luzuloides, *Torr. and Gray, Fl.* 2, *p.* 430. Higher parts of the Rocky Mountains; August.

Cacalia tuberosa, *Nutt. Gen.* 2, *p.* 138. Beyond Westport; June.

Tetradymia inermis, *Nutt. in Trans. Amer. Phil. Soc. l. c. p.* 415. Rocky Mountains; August.

Lobelia leptostachys, *Alph. DC. Prodr.* 7, *p.* 376. Prairie near Westport.

Lysimachia ciliata, *Ait.* West from Westport, Arkansas River.

Asclepias purpurascens, *Linn.* With the preceding.

Asclepias verticillata, *Linn.; β. Torr. in Nicollet's Report, p.* 154. Fort Atkinson. This is a dwarf variety, being often not more than 3–6 inches high.

Asclepias tuberosa, *Linn.* Beyond Westport, Arkansas River.

Apocynum cannabinum, *Linn.* Beyond Westport and Walnut Creek; June, July.

Eustoma Russelianum, *Don; Griseb. in DC. Prodr.* 9, *p.* 51. Near Fort Atkinson; July.

Gentiana affinis, *Grisebach, in Hook. Fl. Bor.-Am.* 2, *p.* 56. In the mountains, near Utah Creek; January.

Ipomæa leptophylla, *Torr. in Frem.* 1st *Report, p.* 94, *and in Emory's Rep. p.* 148, *t.* 11. Walnut Creek; July. Dr. James was mistaken in supposing this handsome species to be an annual. It has a large perennial root, which has endured for four or five years in the Botanic Garden at Cambridge.

Phlox aristata, *Michx.* 1, *p.* 144. West from Westport, Kansas; June.

Gilia pulchella, *Dougl. in Hook. Fl. Bor.–Am.* 2, *p.* 74. Rocky Mountains; August.

Plate III. ASTRGALUS BECKWITHII.

Fig. 1, vexillum; 2, a wing; 3, keel; 4, calyx and pistil; 4, stamens; 6, pistil, the ovary vertically divided. All enlarged.

Plate IV. ŒNOTHERA TANACETIFOLIA.

Fig. 1, vertical section of a flower; 2, stamens; 3, pollen; 4, ovules. All variously enlarged.

Plate V. TETRADYMIA GLABRATA.

Fig. 1, a capitulum; 2, receptacle; 3, a flower; 4, corolla and stamens; 5, corolla and stamens laid open; 6, a stamen; 7, transverse section of the ovary; 8, pistil, with the ovary vertically divided; 9, stigmas; 10, a bristle of the pappus. The details variously enlarged.

Plate VI. PENTSTEMON HETERANDUM.

Fig. 1, a flower; 2, diagram of the æstivation, &c.; 3. 4, normal form for the genus of æstivation of the corolla; 5, vertical section of a flower; 6, corolla laid open, with normal stamens; 7, 8, anterior and posterior view of a perfect stamen; 9, 10, 11, the fifth stamen more or less antheriferous; 12, the fifth stamen reduced to the usual sterile filament; 13, pistil. The details variously enlarged.

Plate VII. PHACELIA HUMILIS.

Fig. 1, a flower; 2, corolla laid open, with the stamens; 3, 4, stamens; 5, pistil and calyx; 6, the same in fruit; 7, capsule, &c., vertically divided; 8, a seed; 9, vertical section of the same. The details more or less magnified.

Plate VIII. PHLOX CANESCENS.

Fig. 1, a flower; 2, the same laid open; 3, 4, stamens; 5, pistil; 6, ovary horizontally divided; 7, vertical section of the ovary. The details variously enlarged.

Plate IX. GILIA GUNNISONI.

Fig. 1, a flower; 2, calyx laid open; 3, corolla laid open; 4, pistil—pistil with the ovary vertically divided; 6, ovary transversely divided; 7, calyx and capsule. Details variously enlarged.

Plate X. ABRONIA FRAGANS.

Fig. 1, a flower; 2, the same laid open; 3, anther; 4, stigma; 5, immature fruit.